PROCESSED ANIMAL PROTEINS FOR SHRIMP FEED

POULTRY MEAL 65 | PORC MEAL 58 | PORC MEAL 65

A HIGH PROTEIN ALTERNATIVE FOR FISH MEAL

As a result of the scarceness of fish meal and higher demand, resulting in high prices, there is a growing interest to replace fish meal with other protein sources. Vegetable protein sources are widely available but the replacement of fish meal by those vegetable proteins is limited in some aquatic species. The main nutritional problems associated with the use of high levels of vegetable proteins are unbalanced amino acid profile, lower digestibility of amino acids, high fiber content, presence of anti-nutritional factors and low availability of Phosphorus.

Processed Animal Proteins (PAPs) are a valuable source of proteins and are the best alternative protein source in those diets.

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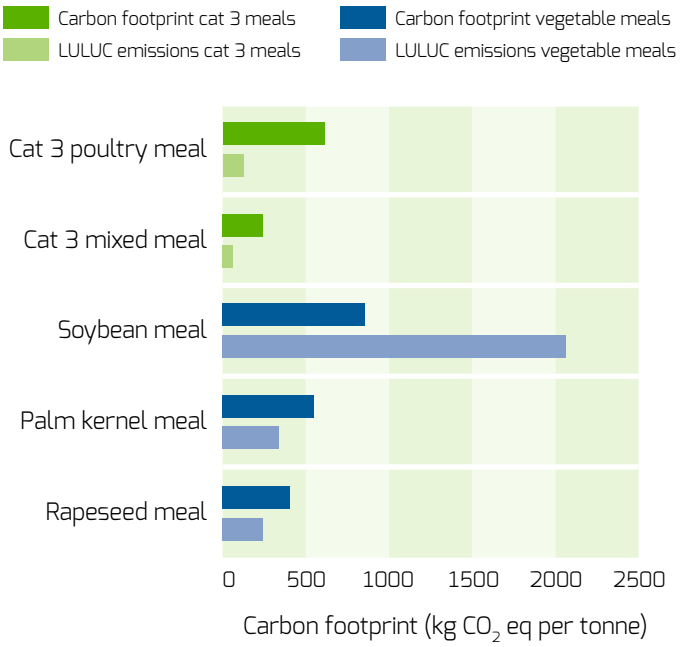
DARLING INGREDIENTS

SUSTAINABILITY

Use of PAPs considerably reduces the carbon footprint of aqua feeds, since these protein sources are locally available and will partially substitute imported soybean meal from the Americas and fish meal from Peru and Chili.

The carbon footprint of PAPs is much lower than vegetable meal's footprints. The emissions related to land use and land use change (LULUC) are higher for the vegetable meals. The carbon footprint of poultry meal comes mainly from the production of the by-products (based on a distribution according to economic value of meat and by-products), plus energy for transporting the by-products and drying of the material.

Carbon footprints of poultry meal and mixed meal and 3 vegetable meals per tonne of products



Ponsioen & Blonk, 2010

Results of trial in Australia (2013): FCR at day 35.
Significant differences with the control diet. Effect of diet and inclusion rate.

Shrimp culture is often criticized for using more fish than producing shrimp (FIFO>1). The use of PAPs will give chances to lower the FIFO considerably.

Apart from sustainability, there are the following nutritional reasons why PAPs are the first protein sources to be used to replace fish meal.

HIGH PROTEIN AND AMINO ACID CONTENT

Table of composition of porc and poultry meal in comparison with the requirement of shrimp

	Poultry meal 63	Porc meal 58	Porc meal 65	Shrimp
Crude protein	63	58	65	32-40
Amino acids (in % of protein content)				
Arginine	6,7	4,7	7,1	5,5
Histidine	1,8	1,9	2	2,1
Isoleucine	3,5	2	3,1	3,4
Leucine	6,3	5,7	6,3	5,4
Valine	4,9	3,3	4,3	4
Lysine	5,7	4,1	6	5,3
Phenylalanine	3,6	2,5	3,5	4
Methionine	1,9	2,2	1,7	2,4
Meth+Cyst	3	1,9	2,3	3,6
Threonine	3,6	4,7	3,5	3,6
Tryptophan	0,9	-	-	0,8

PAPs are rich in most essential amino acids except methionine. They are particularly high in Arginine and other water soluble amino acids (Proline, Glycine, and Glutamic acid), which act as attractant and palatant for shrimp, which is extremely important in pond culture.

DIGESTIBLE PROTEINS

Overview of digestibility coefficients for shrimp compared to other protein sources

	Shrimp (in vivo) Average Digestibility Coefficient (ADC)	Apparent Digestibility of Proteins (ADP)
Fish meal	58-59	76-81
Porc meal	46-54	59-76
Poultry meal	48-63	78-84
Soybean meal	60-67	86-94

Digestibility varies a lot between different PAPs and is affected by quality of raw materials before drying and drying method. A good quality PAP shows digestibility levels that are as high as the highest quality fish meals.

Digestibility tests (with the pH Stat method, for which shrimp enzymes are used) show that poultry by-product meals have a higher digestibility than soybean meal and fish meal.

	PH stat shrimp (DH%)
Sonac PBM High Quality (HQ)	5,21
Sonac PBM Standard Quality (SQ)	4,97
Soybean meal	3,83
Fish meal	3,34-4,71

PARTIALLY SOLUBLE PROTEINS

Both fish meal and PAP contain important amounts of water soluble proteins in the form of peptides or longer chains. These water soluble proteins are highly digestible, but also improve the attractability and palatability of the feeds. Highly digestible proteins are essential in formulating diets for shrimp, which only have a rudimentary intestinal tract. Palatability of diets becomes increasingly important when diets are formulated to contain less fish meal but more vegetable proteins.

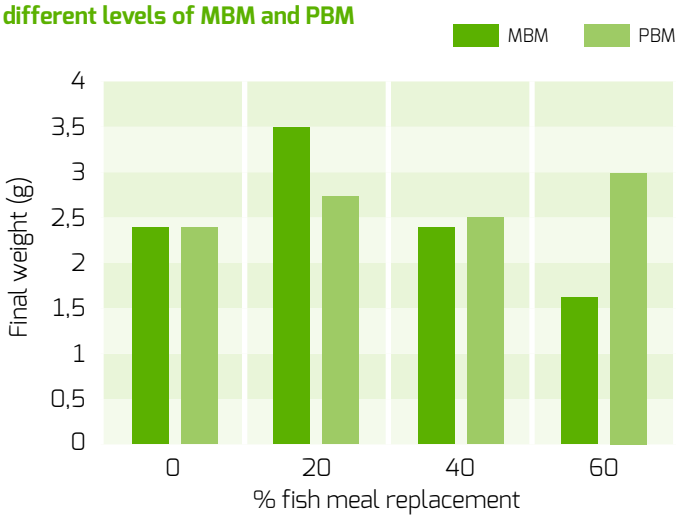
PRESENCE OF DIGESTIBLE P AND CA

Phosphorus digestibility is a major challenge in aqua feed formulation. The phosphorus present in vegetable proteins is mostly trapped in phytin and is not available for the shrimp. The phosphorus present in porc and poultry meal has a higher availability. As a consequence, the faeces of shrimp fed with more animal proteins will contain less phosphorus, that else would find its way into the pond and cause algal blooms.

LOW FIBER CONTENT

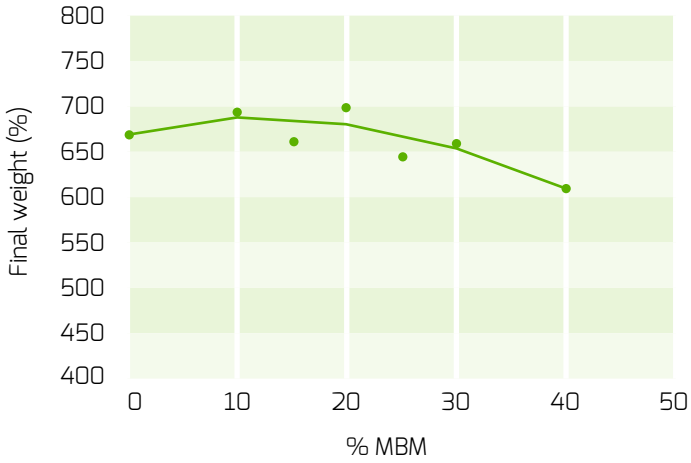
A high fiber content complicates the production of water stable shrimp feeds. Animal proteins contain very small amounts of fibers, in contrast to vegetable proteins that are generally high in fiber.

Growth of Penaeus monodon recieving different levels of MBM and PBM



When fish meal was replaced by Meat and Bone meal (MBM, 40% protein) and Poultry By-product meal (PBM, 63% protein) a growth improvement at 20% replacement was observed. PBM could replace fish meal up to 80% without growth loss. This reduced the fish meal use in the diet to only 5,6% in the carnivorous *P. monodon* (Source: Nguyen et al., 2003).

Growth of Litopenaeus vannamei



Replacement of anchovy meal with Meat and Bone meal in diets for *L. vannamei* gave a growth improvement by replacement up to 50%. Even at the higher levels of MBM, growth of the shrimp was similar to the shrimp on non-substituted fish meal diets. In the feed with 30% MBM anchovy meal was reduced from 40% to 16% of the diet (Source: Tan et al., 2005).

PRESENCE OF SOME NUTRIENTS

Due to the ever increasing scarcity of fish meal, their is a continuous search for replacement of fish meal. Replacement is possible up to a certain level, but total replacement often results in growth loss, even though diets contain the same amounts of essential nutrients according known requirements.

Replacing fish meal by PAPs generally results in better results than replacing fish meal by vegetable proteins. Likely there are nutrients, which are present in animal proteins like hydroxyproline, taurine and nucleic acids that have added value, but their function needs further elucidation.

CONCLUSION

Porc and poultry meal are high quality protein sources and the first alternative for fish meal in shrimp feeds. They are very well digested by shrimp, contain a lot of interesting nutrients, and are a better alternative than vegetable protein sources. They are low in fiber content and contain better digestible phosphorus.

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