

Adding value to feathermeal

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Million tonnes of fishmeal are used worldwide in all animal feeds each year, including aquaculture. The proportion of the world's fishmeal used for aquaculture is estimated to reach 66% by 2013, though production will stagnate or even fall in 2009 (*IFFO, 2008; forecasts*).

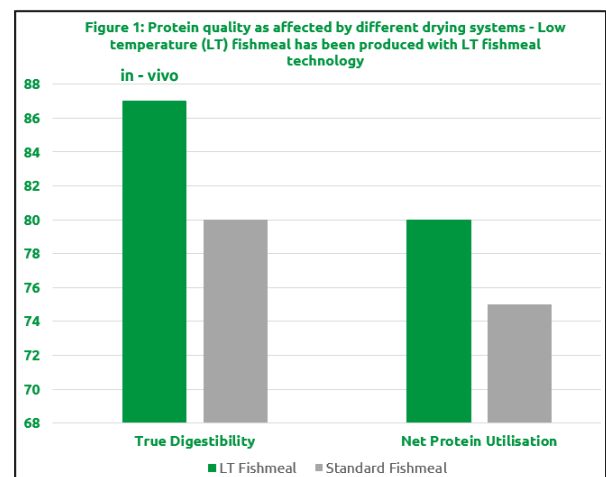
If aquaculture is to grow as expected, alternatives to the limited availability of fishmeal for aqua feed have to be found. Additionally, increasing prices of fishmeal are forcing the industry to decrease the inclusion level of fishmeal and to increase the usage of alternative, more economical feed ingredients.

Hydrolysed poultry-based animal proteins - for example hydrolysed feathermeal - are economically interesting protein source used in specific areas of aquaculture such as in salmonid feed. These proteins are less expensive, palatable, and free of anti-nutritional factors and by virtue of their origin free from any marine-based diseases are hence considered bio-aqua-secure. However, the use of feathermeal has been limited for reasons such as poor digestibility.

Unprocessed feathers are high in crude protein (90 percent), but are highly indigestible due to the keratin structure, which contains high amounts of cross-linked – disulphide bonding – cysteine. In order to open the S-S bonds and to make the

crude feathers available for digestive systems, feathers have to be processed.

Currently, processing in continuous hydrolyser is recognised as the state-of-the-art process resulting in a maximum of degree of hydrolysis or cooking. Several factors are known to modify digestibility of protein and amino acids. Among these process conditions the drying conditions in particular, seem to play a major role in respect to digestibility and nutritional quality of hydrolysed feathermeal.



The purpose of drying is to convert wet, unstable materials into a dry and stable substance. The drying is done by heating the material to a temperature where the rate of evaporation is considered satisfactory. Increasing the temperature will speed up the drying process but can easily result in impairing nutritional values.

Hot air

Hot air dryers have already started to attract the interests of the fishmeal producers; the principle of a hot air drying is applied in the low temperature (LT) fishmeal technology. It is a two-step hot air drying characterized by short-term retention and moderate temperatures ensuring that protein quality retains at high levels.

In the fishmeal manufacturing this drying process is considered as the most critical unit operation affecting the quality and the nutritional value of fishmeal.

In contrast to the fishmeal industry (producing LT fishmeal) indirect drying systems such as rotary disc dryer are still common practice in the poultry by-product rendering operation. The main effect due to excess of heat application is the disruption of the hydrogen bonds in protein structures leading to protein denaturation.

In this case denatured amino acids cannot be recognised physiologically as amino acids and are utilised, after deamination, as a very expensive source for energy only, thus leaving their fullest potential unexploited.

The LT fishmeal technology imparts minimal denaturing effects on proteins, thus preserving inherent digestibility and biological value. A comparison regarding specific quality aspects is shown in **Figure 1**.

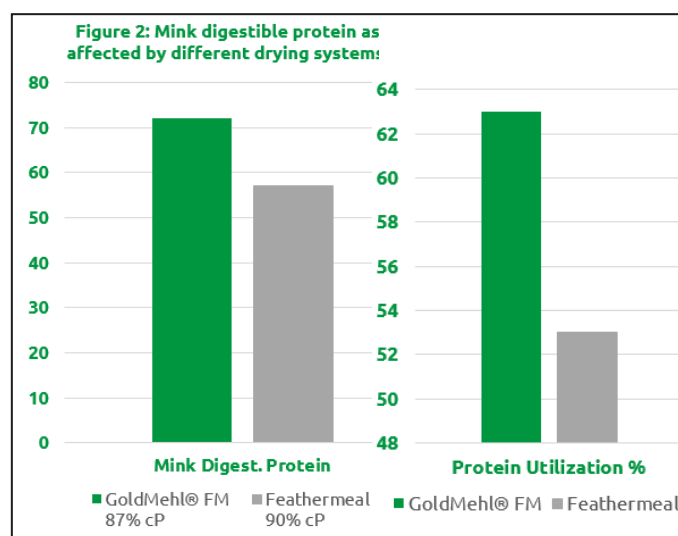
Superior to disc drying

LT fishmeal is superior to standard fishmeal originated from a drying process based on disc drying. Realising the beneficial effects of a LT fishmeal drying system GEPRO Geflügel-Protein Vertriebsgesellschafts mbH & Co.KG has recently launched a new product category of processed poultry by-products based on the LT fishmeal drying system.

Under the brand name GoldMehl® FM, a special processed hydrolysed protein of poultry feathers origin has been developed specifically for aquaculture. In several *in vivo* trials, conducted at the "Fiskeri Forskning Institute of Fisheries and

Aquaculture Research" at Tromsø in Norway using minks as a model for fish, (salmons in particular) the biological digestible protein of GoldMehl® FM has been assessed.

In comparison with standard / regular feathermeal (produced with a disc dryer) the mink digestible protein and the biological utilisable protein of the hydrolysed feathermeal manufactured by LT fishmeal technology was clearly superior (see **Figure 2**).



Fishmeal substitute

In addition, the mink digestible protein of GoldMehl® FM was very similar to fishmeal (data not presented) indicating good potential of GoldMehl® FM as a fishmeal substitute.

Differences in protein quality of processed poultry by-products have been observed in a number of studies (Cho and Slinger (1979); Cho et al. (1982); Pfeffer et al. (1995); Sugiura et al. (1998), Hajen et al. (1993), Dong et al. (1993). Optimisation of the cooking and drying conditions are considered to be the main factors contributing to the high digestibility values now observed for poultry by-product meal (Miller, 1996).

The negative correlation between the drying conditions and protein quality could also demonstrated by Cho et al., 1982 indicating that spray-dried blood meal was almost completely digestible.

In contrast, plate-dried steam-tube dried and ring-dried blood meal had a significantly lower apparent digestibility compared to spray-dried blood product.

Heat-damage has previously been shown to have a very

significant negative impact on digestibility of protein of blood meal produced under different drying systems (disc-dryer, spray-dryer, and flash-dryer).

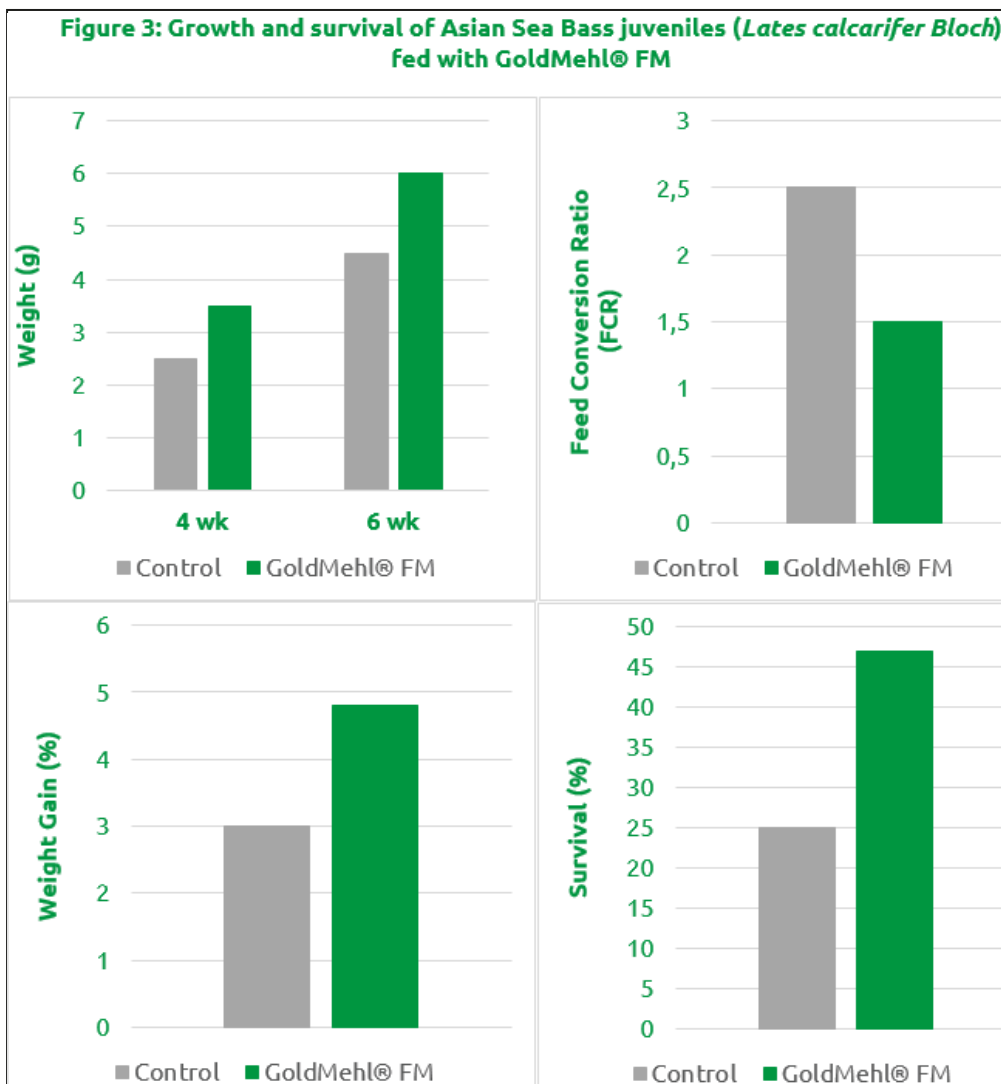
Feeding trials

A series of feeding trials were conducted using Asian Sea Bass juveniles (*Lates calcalifer*) to evaluate the potential of GoldMehl® FM as a protein sources in the diet.

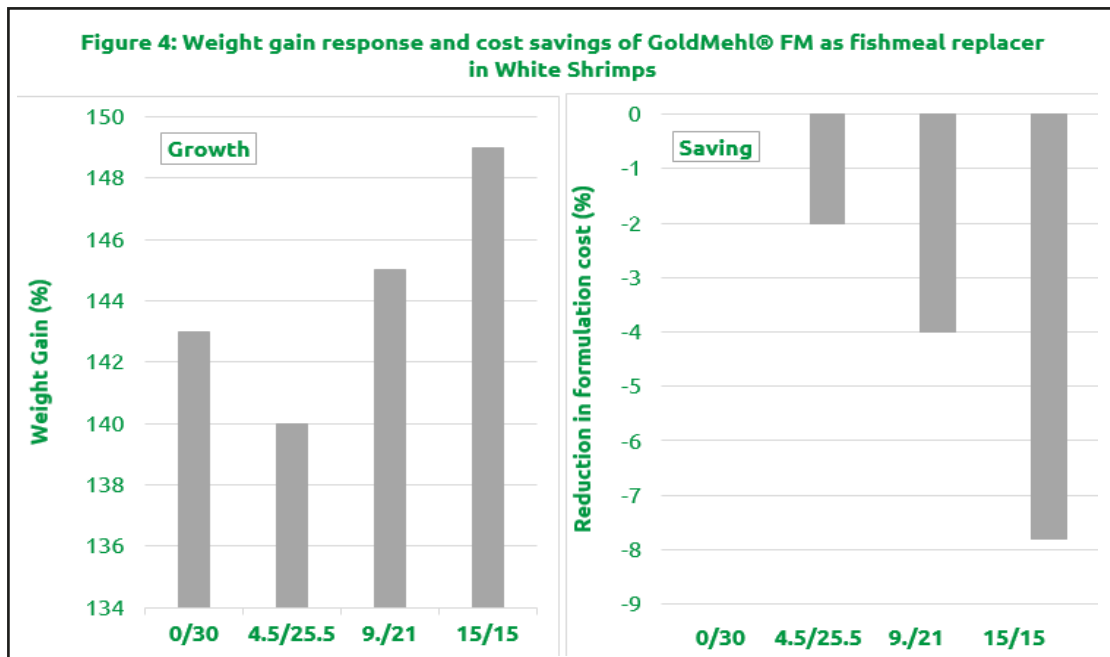
In one of these trials GoldMehl® FM has been incorporated into commercial available feed. As indicated in **Figure 3** GoldMehl® FM showed a significant improvement of different growth parameters (weight gain, FCR, PER) and survival rate.

Optimal levels for shrimp

In another feeding trial the nutritional value of GoldMehl® FM as a replacer for fishmeal has been tested in White shrimps (*Penaeus vannamei*). In different treatments fishmeal has been gradually replaced by GoldMehl® FM at various ratio (zero percent GoldMehl® FM/ 30 percent fishmeal = 0/30; 4.25 percent GoldMehl® FM/ 25.5 percent fishmeal = 4.25/25.5; 9/21; and 15/15). Results indicate that growth of shrimps under the test conditions was optimal at a level of 15 percent GoldMehl® FM and 15 percent fishmeal, resulting in cost savings in the diet formulation of almost 8 percent



(see **Figure 4**). These findings are in line with studies conducted in Hawaii where hydrolysed feathermeal was given as fishmeal replacer to shrimps (*Cheng et al., 2002*). It was concluded that without losing growth performance hydrolysed feathermeal could replace fishmeal. Substitution rate for fishmeal by feathermeal was assessed to be 55 percent without and 66 percent with supplementing of crystalline lysine and methionine. A positive performance of shrimps fed with processed poultry derivatives as fishmeal substitute has been observed in fresh water shrimps (*Macrobrachium Nipponese*). White shrimps (*P. vannamei*) and Black Tiger (*P. monodon*) cultivated in various areas. (Cited in Yu, 2006 *Essential Rendering*).



Conclusions

GoldMehl® FM has a nutritional composition and feeding values similar to that of fishmeal for shrimps and better than regular feathermeal. Although the raw material is poultry feather, the superiority of GoldMehl® FM is attributed to its special process which is very similar to the production conditions of high valuable LT fishmeal. GoldMehl® FM has the potential to partly substitute fishmeal and help to reduce formulation costs. Applying a state-of-the-art drying process to the production of feathermeal creates an added value to feathers. The recycling of feathers is environmental friendly and is able to partly release pressure on marine raws. Further, it can be regarded as sustainable protein production in the wake of increasing poultry production in all the parts of the world.

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