



# The effects of fish hydrolysate in the diet on growth, optimal utilization and healthy of marine fish

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# Lower usage of limited marine - harvested ingredients is a major sustainability challenge facing the aquafeed industry

## The practical value of a plant ingredient comprises :

- its nutritional criteria (IAA profile, nutrient availability, DE supply)
- effects on palatability
- presence of anti - nutritional factors (ANFs)
- its technological constraints
- its market availability (cost, traceability,...)

**Is there room to upgrade its value?**

# The opportunity to upgrade plant ingredients came through with fish hydrolysates supplements

## What is fish protein hydrolysate?

- ✓ Fish protein hydrolysate is made from whole fish or fish offal from filleting industries.
- ✓ Hydrolysed proteins are proteins which are treated enzymatically in order to make them shorter.

## What are the potential benefits

- ✓ Good attractants
- ✓ Beneficial effects on larval growth, survival and development
- ✓ Immune stimulants
- ✓ Enhanced production economics resulting from improved nutrient digestion
- ✓ Reduced environmental impact

# The opportunity to upgrade plant ingredients came through with fish hydrolysates supplements

- Fish industry is a relevant product opportunity for utilization of this protein source as feed ingredients, either as silage or as enzymatically treated hydrolysate.
- Processing of fish hydrolysate and silage from the by-products is applicable.

**Native protein**

**Heat or low pH**

**Denatured protein**

**Proteases**

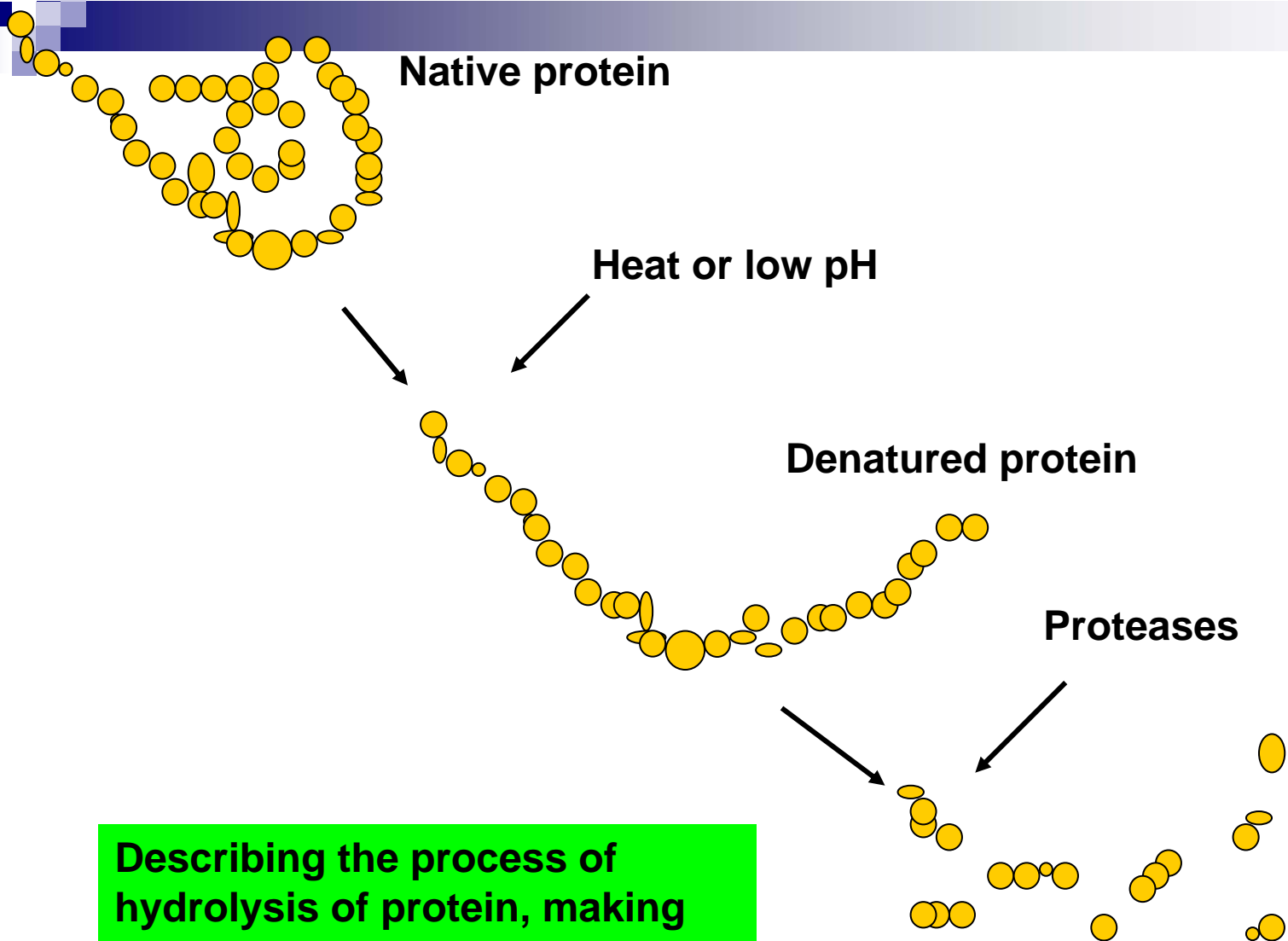
**Oligo-peptides**

**Tri-peptides**

**Di-peptide**

**Amino acids**

**Describing the process of hydrolysis of protein, making the protein solubilised**



*The illustration shows two different processes to achieve fish protein hydrolysates.*



***Silage***



***Hydrolysed proteins***

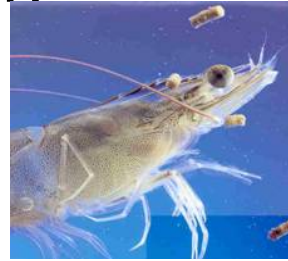


***Dried hydrolysate***

# Fish hydrolysate as attractant

- A good fish attractant should be highly palatable to the target species, contribute to the nutrition of feed, minimize the time the feed stays uneaten in the water, and reduce wastage.
- Hydrolysate have the advantages of containing a complex cocktail of amino acids, peptides and other attractant inherent to nutrient value. Low temperature processing is known to be vital to maintain functionality and enzyme hydrolysis will enhance performance.
- It is important that during hydrolysis fish protein should not be hydrolysed entirely to free amino acids.

# Attractive effects of experimental attractants on shrimps( *Penaeus chinensis*)



Attractant	Content	Attractant rate (%)
5'-inosine-monophosphate	1%	0
Betaine	2%	53.8
Fish hydrolysate	2%	58.6
TMA-O	0.25%	0



# Improvement on growth, feed utilization and development

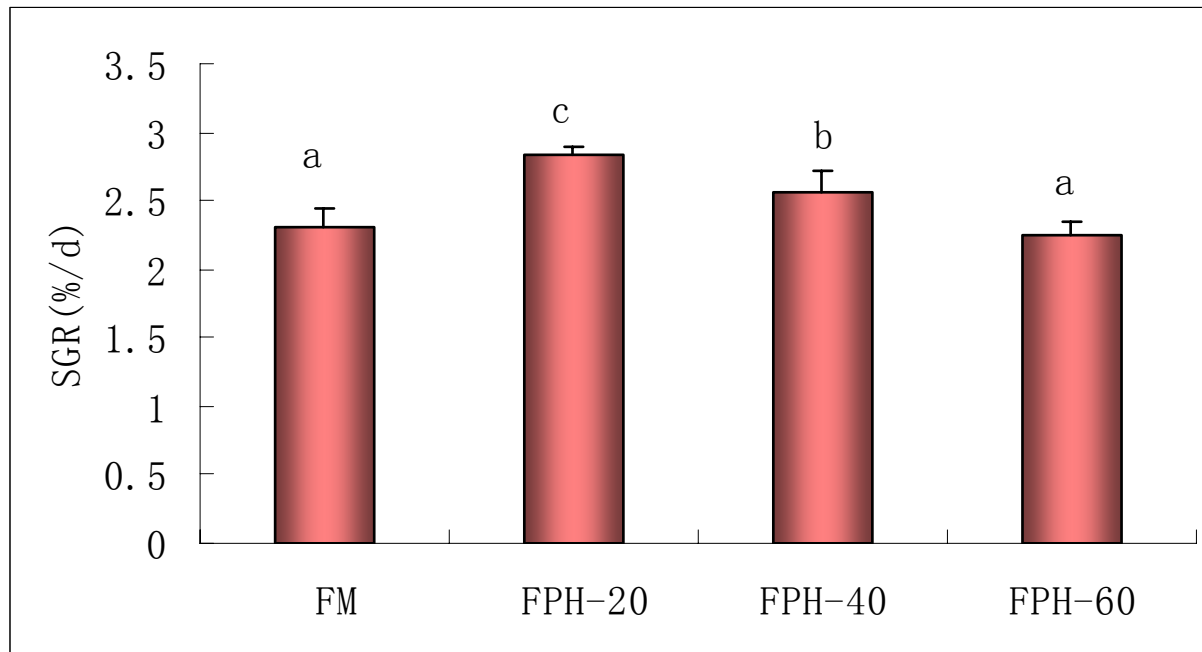
- Incorporation of fish hydrolysates into fish larval diets may have particularly beneficial effects on larval survival, growth and development.
- Fish larval have a poorly developed digestive tract and have difficulty assimilating intact protein.
- In exchange of fish meal, fish hydrolysate generally shows a beneficial effect on growth performance and feed utilization at low inclusion levels, but decreased performance when exceeding a specific dietary level.

# Effects of different levels of fish protein hydrolysate in the diet on growth performance and physiological indices of tongue sole post-larvae

## FEED FORMULATION

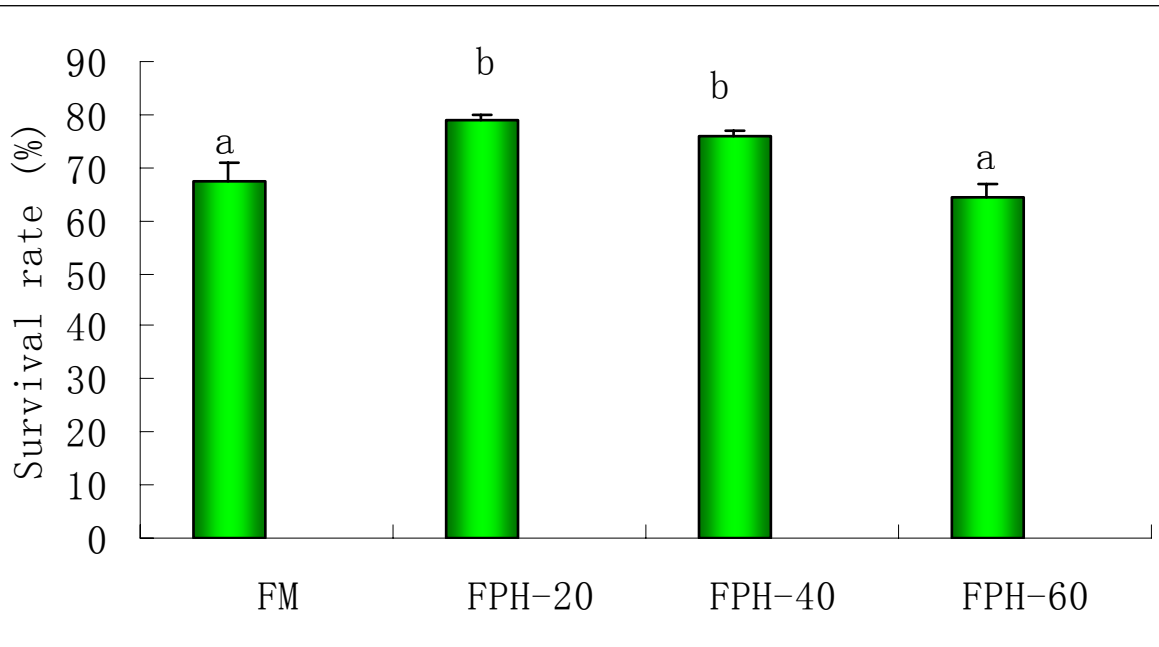
Ingredients	Diet group			
	FM	FPH-20	FPH-40	FPH-60
Fish meal	77	50	25	2
FPH	0	20	40	60
Mussel meal	10	10	10	10
Fish oil	6	8	9	9.5
Lecithin	2	2	2	2
Betaine	0.3	0.3	0.3	0.3
$\alpha$ -Starch	2.6	7.6	11.6	14.1
$\beta$ -carotene	0.1	0.1	0.1	0.1
Vitamin mix	1	1	1	1
Mineral mix	1	1	1	1

# Effect of different FPH on growth of tongue sole post-larvae



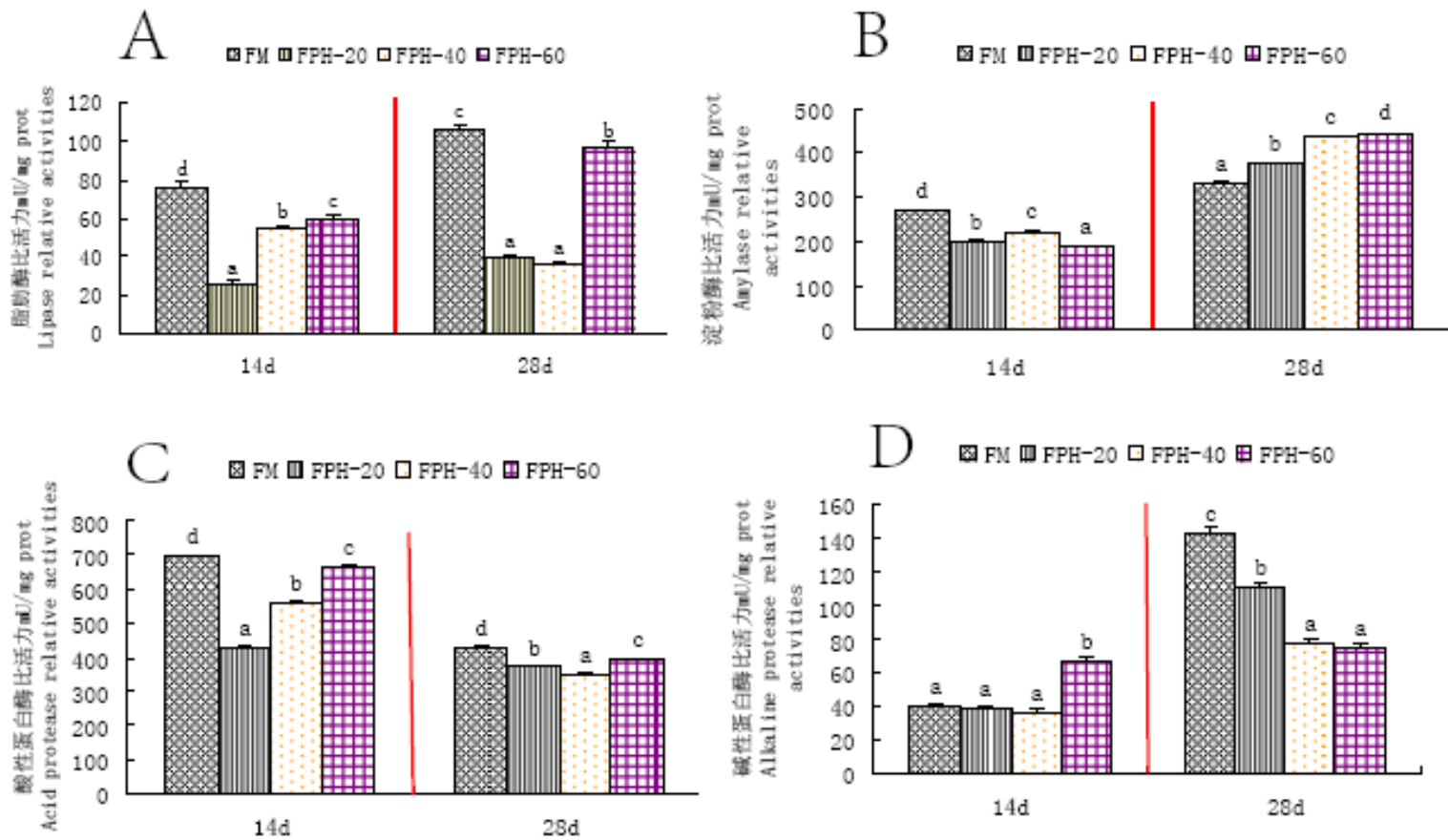
The highest SGR was obtained in the group fed FPH-20 ( $2.84 \pm 0.06$ ) %/d,

# Effect of different FPH on survival of tongue sole post-larvae



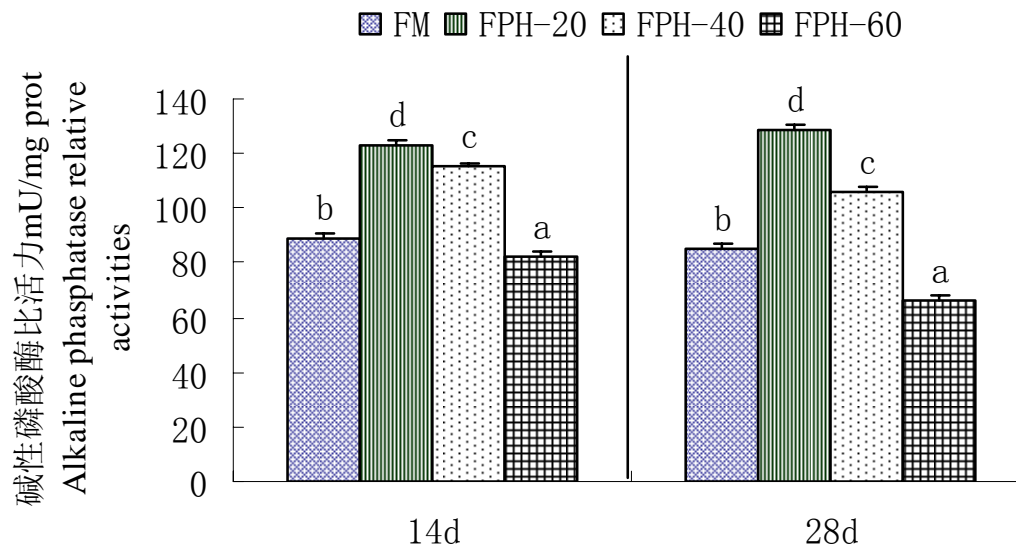
The highest survival was obtained in the group fed FPH-20 ( $78.88 \pm 0.96$ ) %. The tongue sole larvae showed a tendency: FPH-20 > FPH-40 > control > FPH-60 in survival.

# Effects of FPH on digestive enzymes relative activities in tongue sole post-larvae

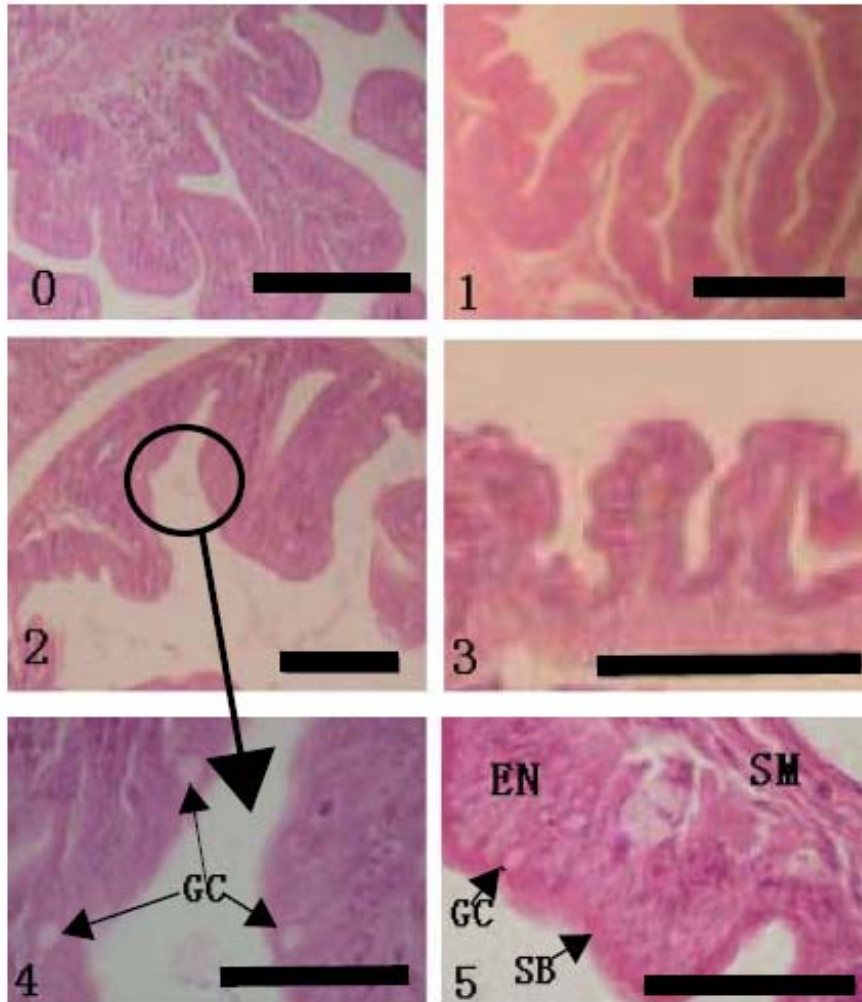


(A) Lipase; (B) Amylase; (C) Acid protease; (D) Alkaline protease

# Effect of FPH on alkaline phosphatase relative activities in tongue sole post-larvae



# Effect of FPH on intestine structure in tongue sole post-larvae



it was detected that the fish fed with FPH-20 was best, worst when fed with FPH-60 on intestinal tract development

# Effects of different levels of fish protein hydrolysate in the diet on the growth of Japanese sea bass, *Lateolabrax japonicus*



Growth performance of sea bass fed the experimental diets

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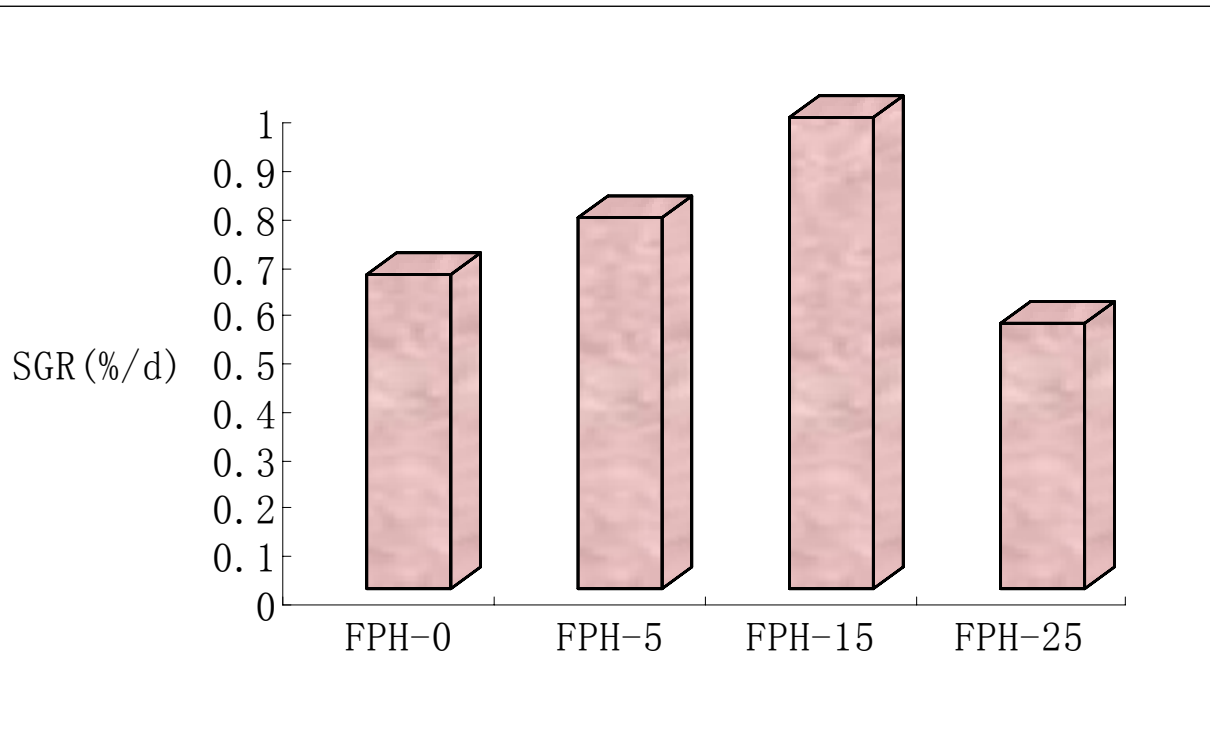
Dietary FPH (%)	0	5	15	25
SGR(%)	0.62 <sup>a</sup>	0.69 <sup>a</sup>	0.93 <sup>b</sup>	0.78 <sup>ab</sup>
FCR	0.89 <sup>a</sup>	0.87 <sup>a</sup>	1.03 <sup>b</sup>	1.05 <sup>b</sup>

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Means within a row having different superscripts are significantly different ( $P < 0.05$ )

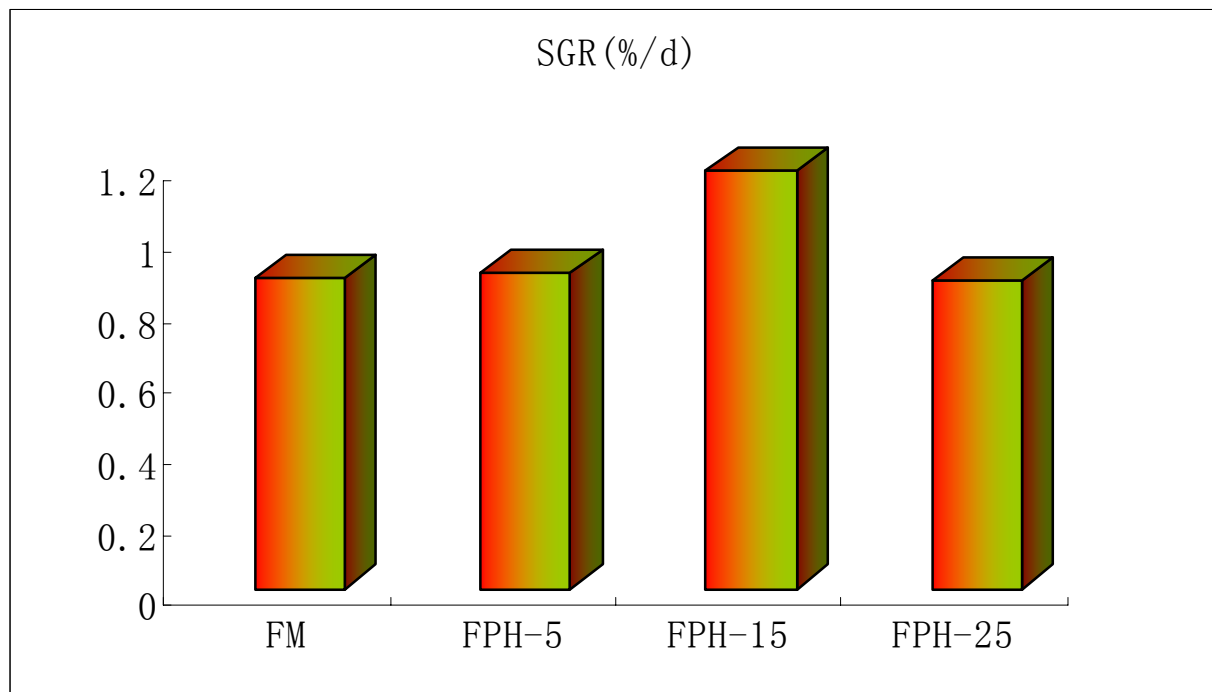


# Effects of different levels of fish protein hydrolysate in the diet on the growth of Japanese flounder (*Paralichthys olivaceus*)



Flounders

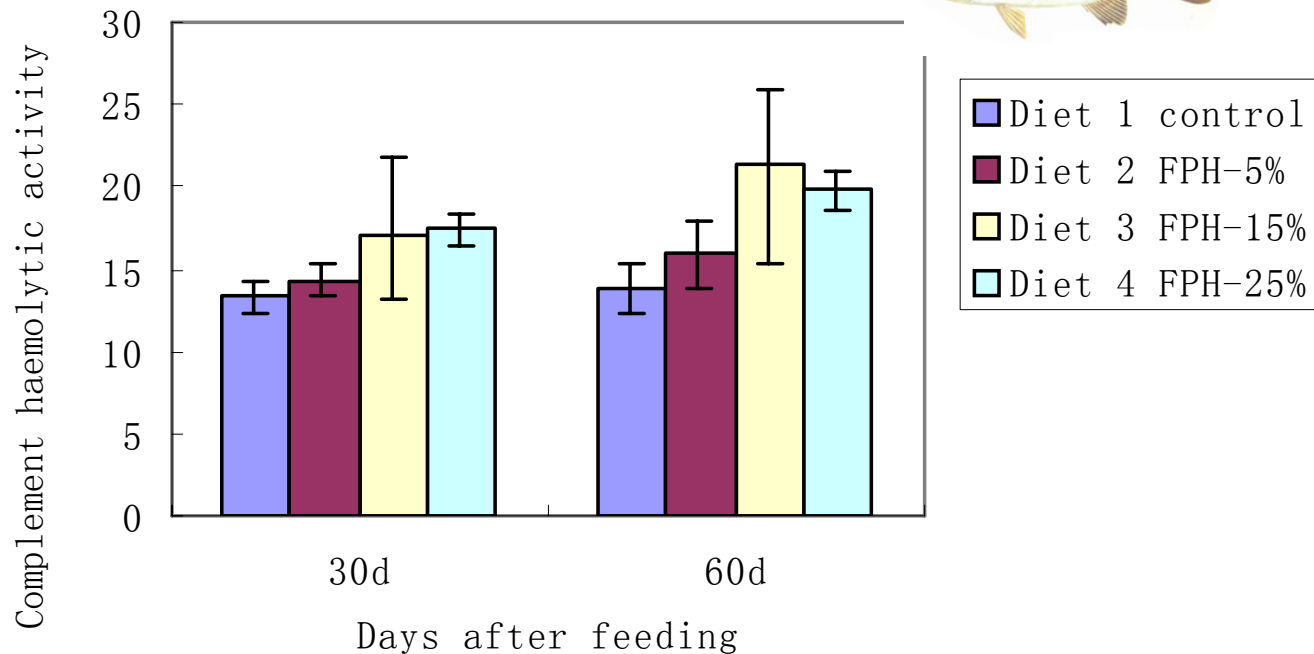
# Effects of different levels of fish protein hydrolysate in the diet on the growth of turbot



# Immune stimulant effects

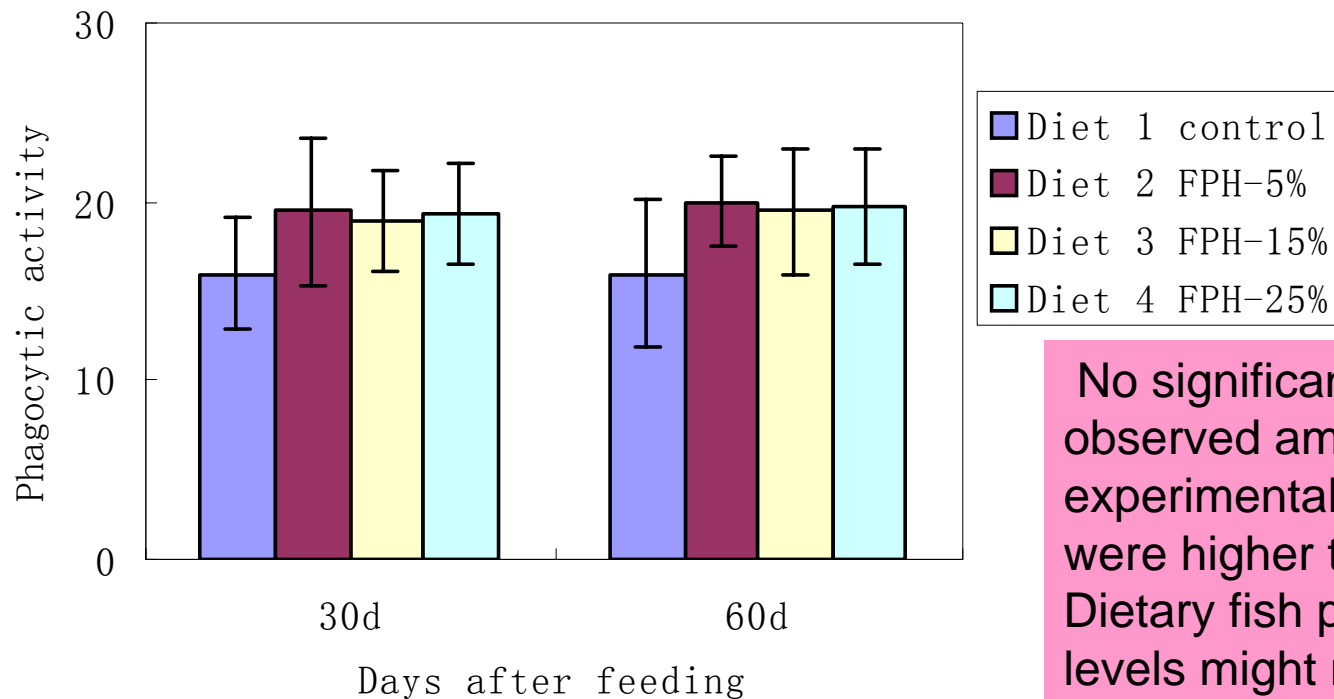
- Immune stimulants are able to activate white blood cell activity and improve resistance to disease microorganisms.
- Various biochemical precursors such as peptides, nucleotides and glutamic acid, all of which are present in fish hydrolysate, strengthen the immune function.

# Effects of different levels fish protein hydrolysate on complement haemolytic activity of sea bass.



The complement haemolytic (CH50) activity in control was almost similar to that of the FPH-5%, but there was a significant increase in FPH-15% and FPH-25% on 60 days.

# Effects of the different levels fish protein hydrolysate on the phagocytic activity.

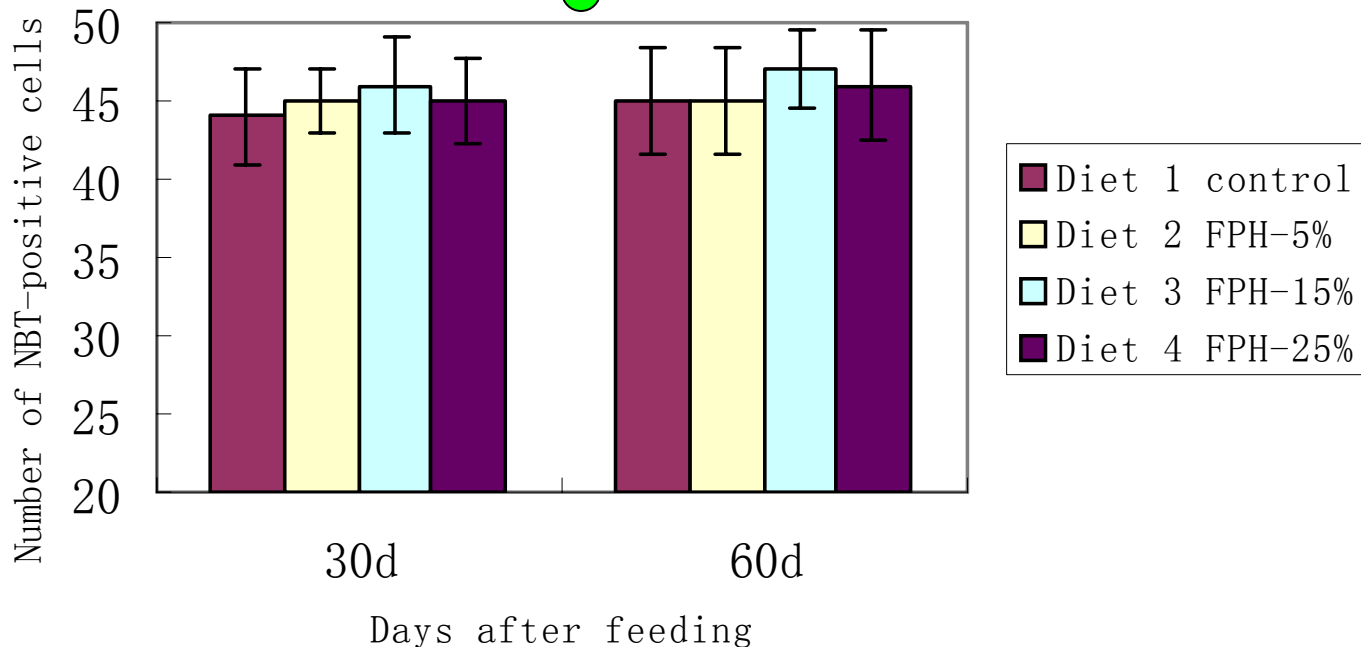


No significant differences were observed among all the experimental groups, but they were higher than that of control. Dietary fish protein hydrolysate levels might not have a significant influence on phagocytic activity in sea bass.

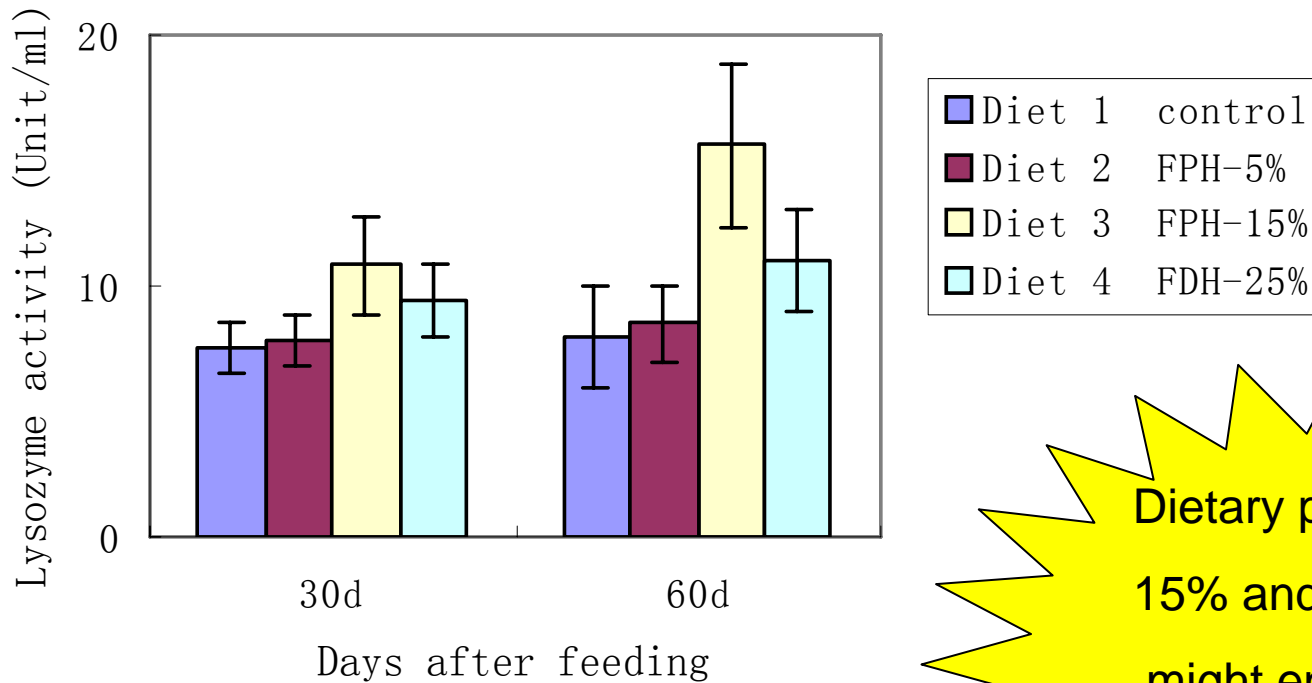
# Effects of the different levels fish protein hydrolysate on NBT-cells of sea bass.



The number of NBT-positive cells were similar in all experimental diet, there were no difference in the number of NBT-positive cells

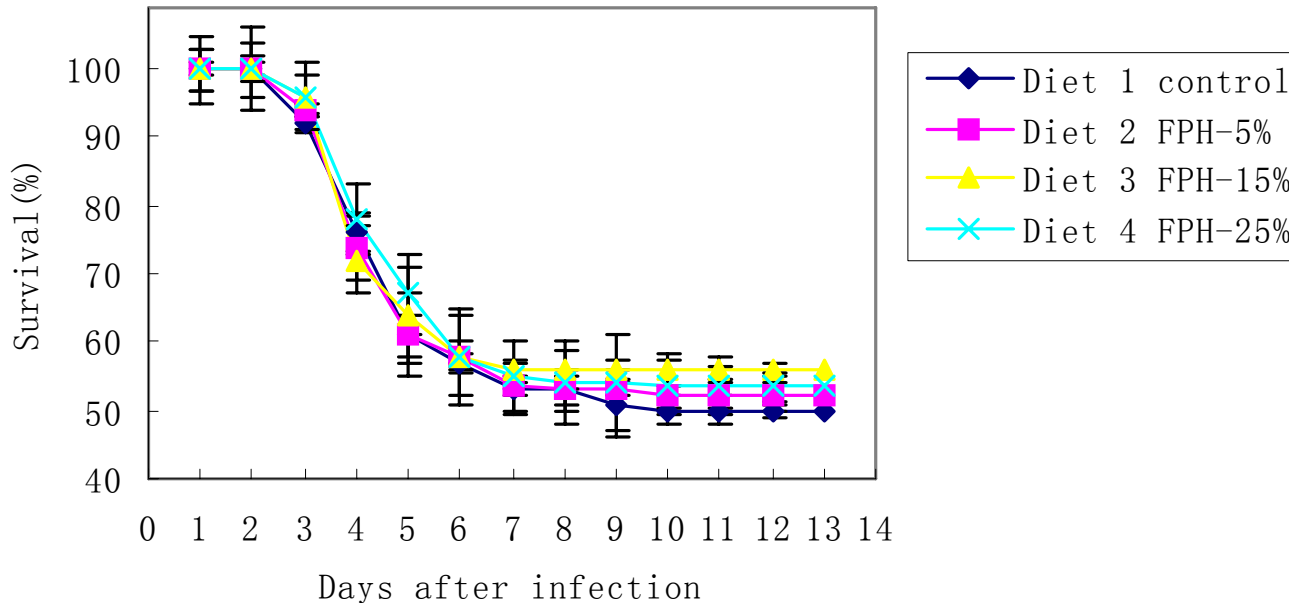


# Effects of different levels fish protein hydrolysate on the lysozyme activity of sea bass



**Dietary protein replaced  
15% and 25% FPH diet  
might enhance lysozyme  
activities of sea bass.**

# Survival rate of sea bass exposed to *V. anguillarum* for 14 days



The survival rate in FPH-5% and FPH-15% had slightly higher than that in control, but no significant difference in survival rate ( $P>0.05$ ).





**THANK YOU VERY MUCH  
FOR YOUR ATTENTION**