Nutritional components affecting quality in marine fish larval development

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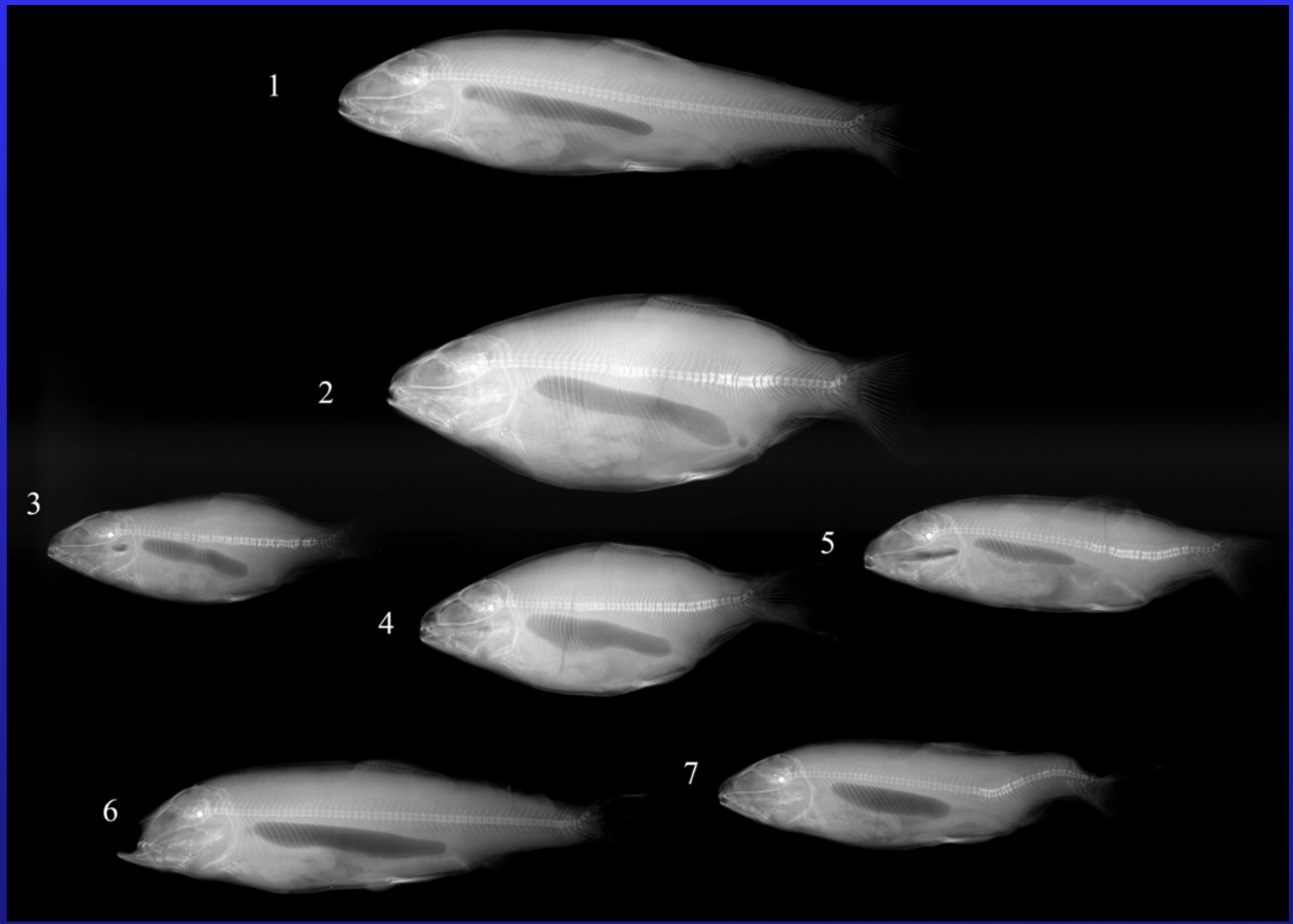
Larvi'01, Sept. 3-6, Ghent University

Types of abnormalities

- Skeletal deformities (mainly in round fish)
  - Scoliosis
  - Lordosis
  - Coiled vertebral column
  - Missing or additional fin rays
  - Jaw malformation
- Default in pigmentation (mainly in flat fish)
  - In ocular side
  - In blind side
- Low stress resistance
  - Handling stress
  - Exposure to low salinity

Skeletal deformities



Factors involved in malformations in fish larvae

- Hydrodynamic in tanks
- Physical parameters

  light, salinity,temperature
- Congenital default inducing defective embryonary development
- Nutritional factors

Nutritional factors involved in the quality of the development

- Phospholipids
- HUFA
- Peptides
- Amino acids, such as tryptophan
- Retinoic acid
- Ascorbic acid

Phospholipid requirements in fish larvae

Phospholipid synthesis in fish larvae is too low to meet larvae requirements

⇒Essentiality of dietary phospholipid

- for growth
- for survival
- for normal development

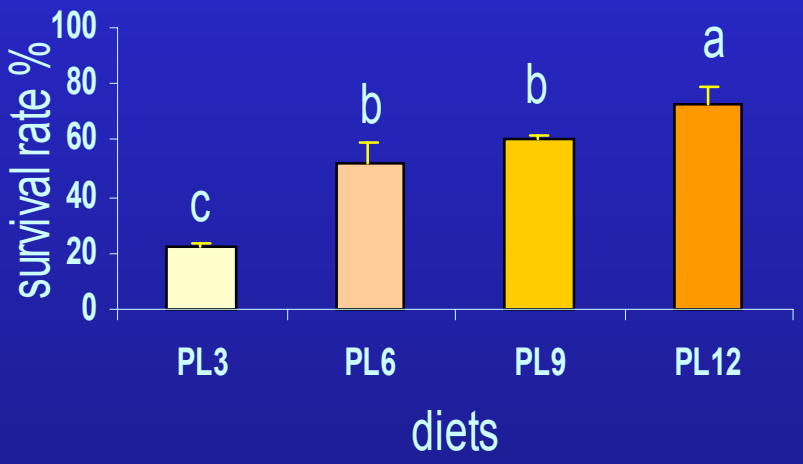
Effect of dietary PL on sea bass development
Lipid composition of the experimental diets

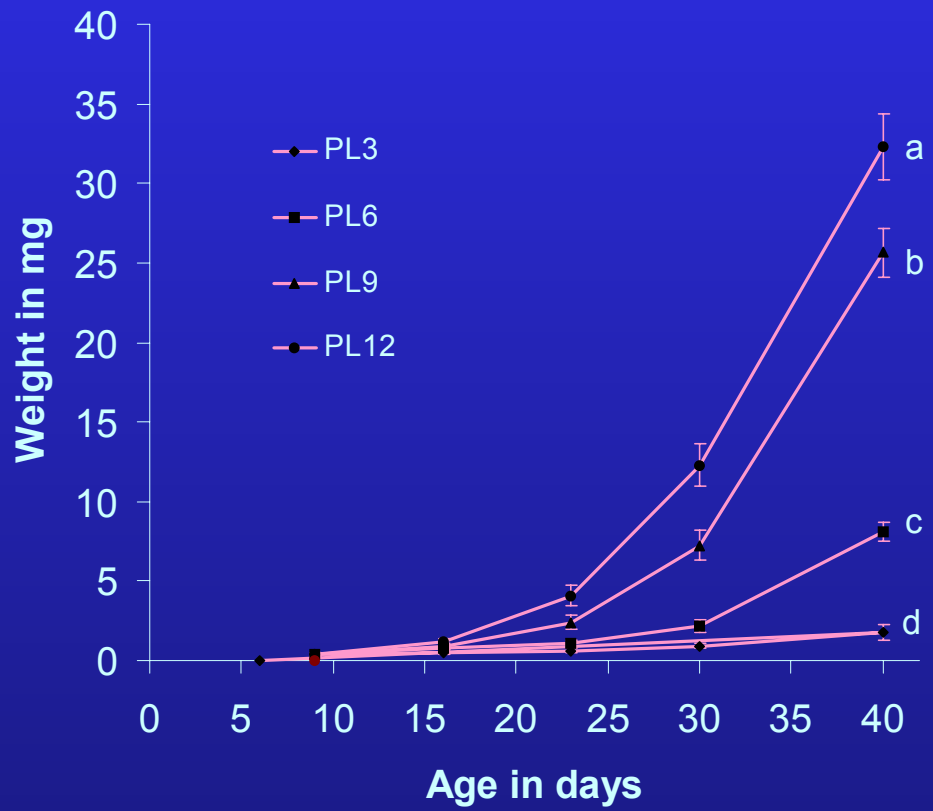
		PL3	PL6	PL9	PL12
		g/100 g dry diet			
Added lipid in diets	Soybean lecithin	0	5.6	11.1	16.7
	Fish oil	16.7	11.1	5.6	0
Lipid composition	Neutral lipids	22.9	20.3	17.3	13.7
	Phospholipids	2.7	6.0	9.1	11.6
	Phosphatidylcholine	0.9	1.8	2.6	3.5
	Phosphatidylinositol	0.2	0.7	1.2	1.6
	EPA+DHA	4.9	3.6	2.4	1.5

(Cahu and Zambonino, in press)

Effect of dietary PL on sea bass larval development

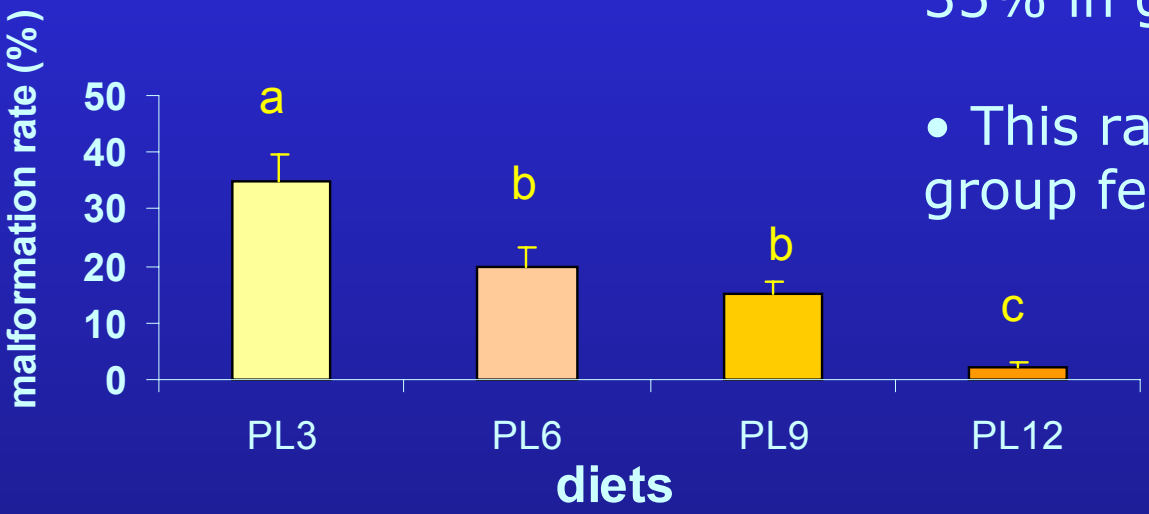
Survival and growth





Effect of dietary PL on sea bass larval development

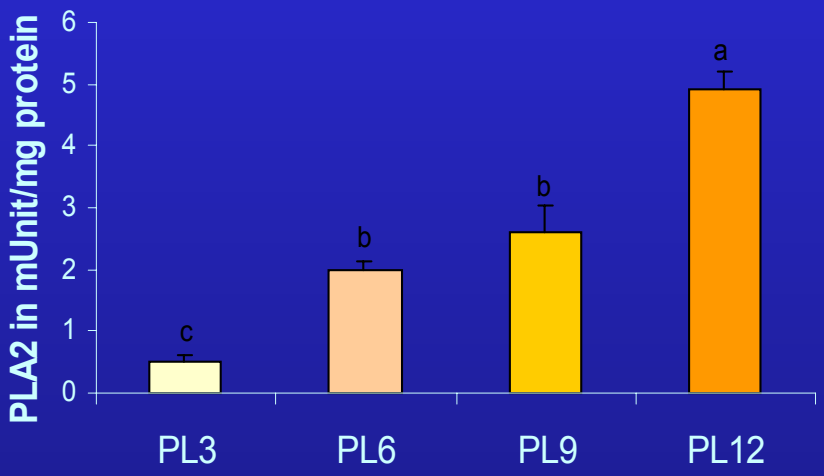
Malformation rate

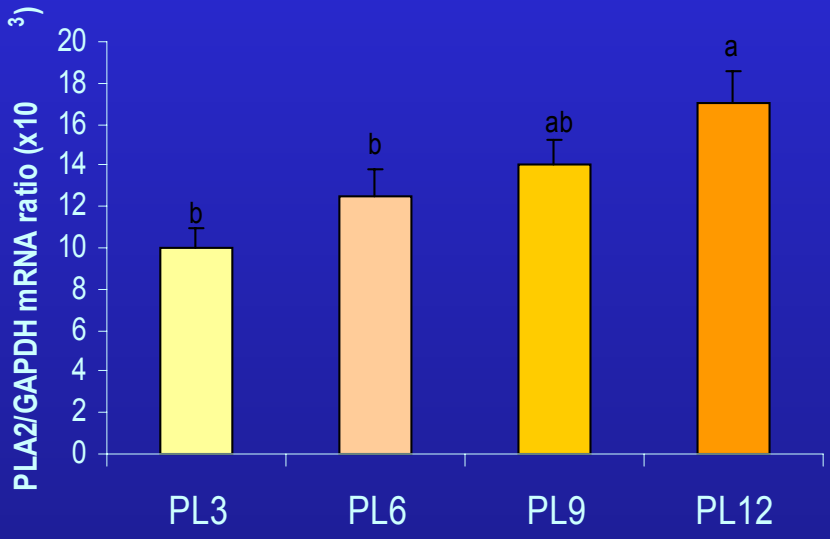


- Malformation rate reached 35% in group fed PL3;
- This rate was only 3% in group fed PL12

Effect of dietary PL on sea bass larval development

Phospholipase activity

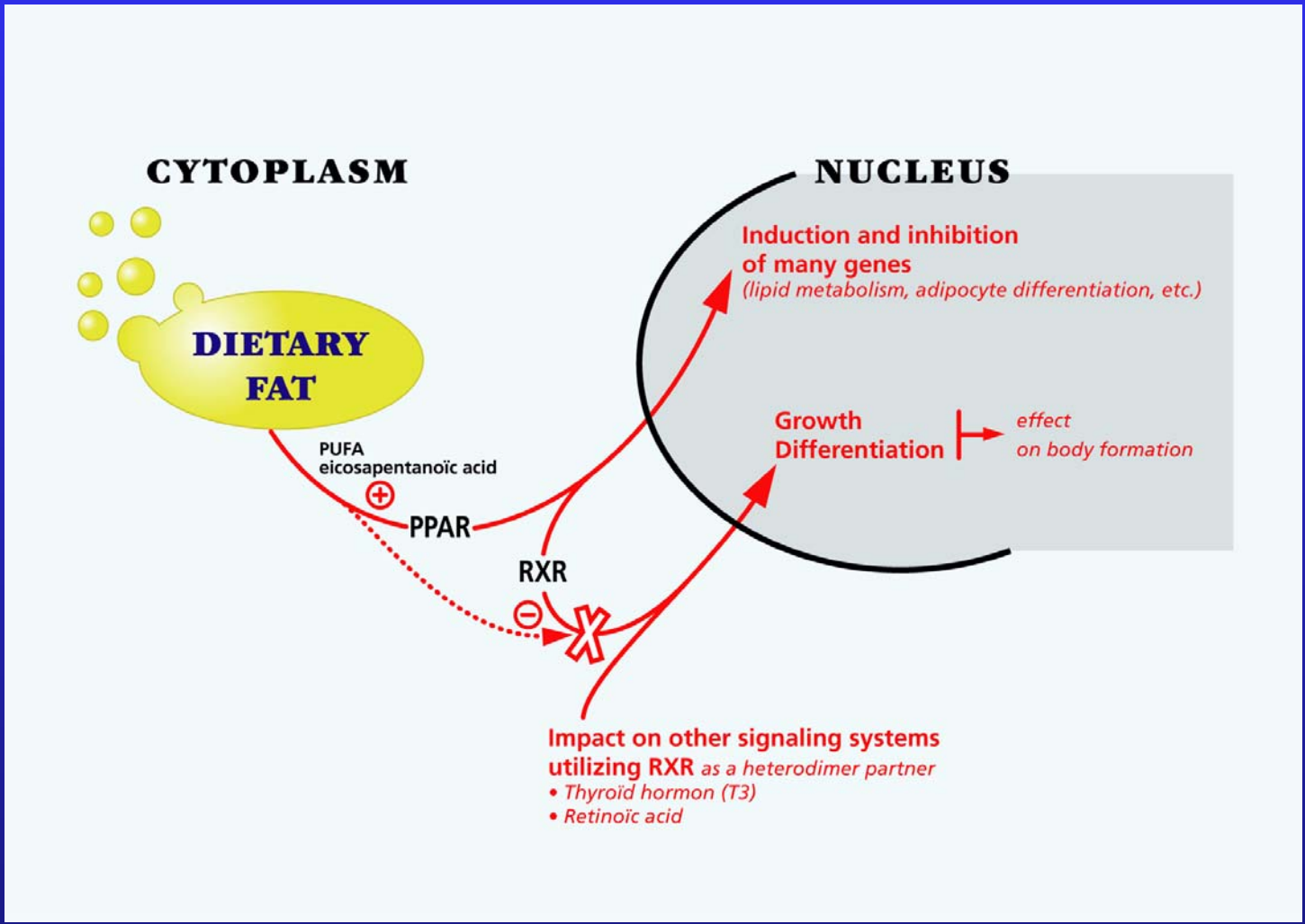




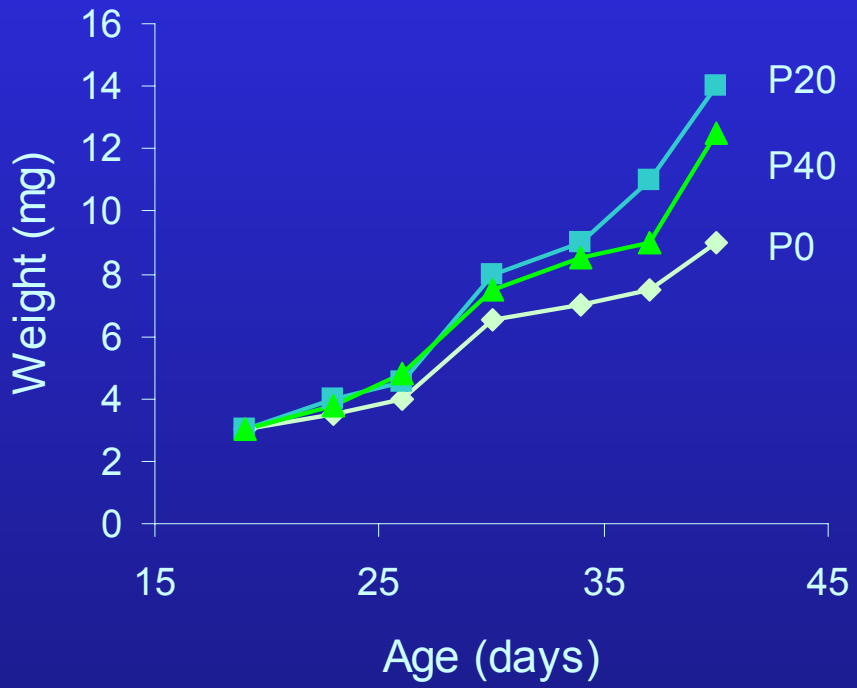
Positive effect of different HUFA
on development of some fish species

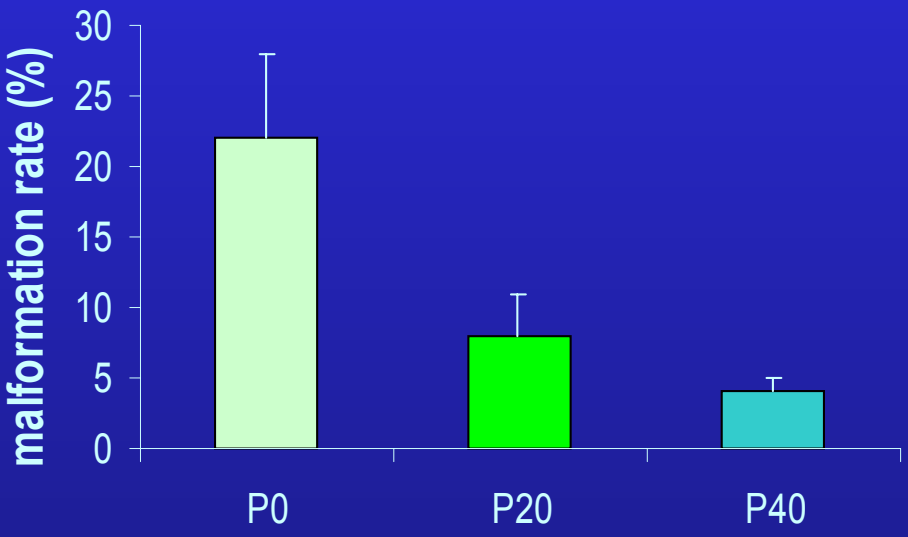
	Pigmentation	Nervous system	Vitality	Malformations
EPA C20:5n-3	Turbot *(Estevez et al., 1999)*	Japanese flounder *(Furita et al., 1998)*		
DHA C22:6n-3	Halibut *(Schields et al., 1999)*	Japanese flounder *(Furita et al., 1998, Bell et al., 1995)*	Red seabream *(Watanabe and Kiron, 1994)*	Milkfish *(Gapasin and Duray, 2001)*
ARA C20:4n-6	Negative effect in Turbot		Gilthead seabream *(Koven et al., 2001)*	

Effect of HUFA on gene expression



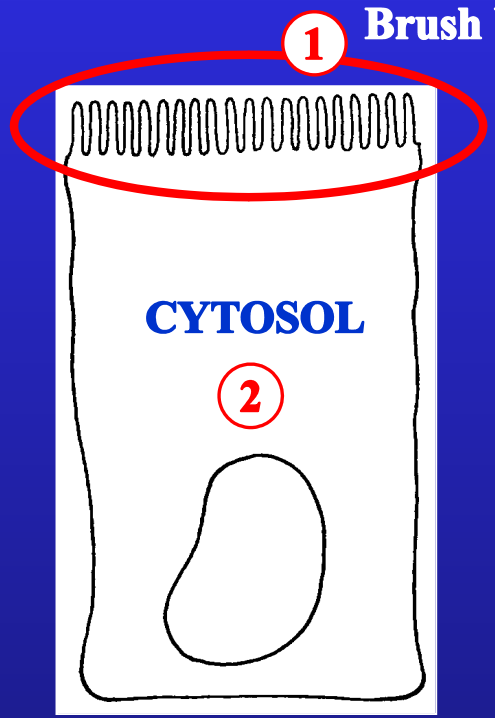
Effect of dietary peptides on sea bass development : growth, survival and malformation rate

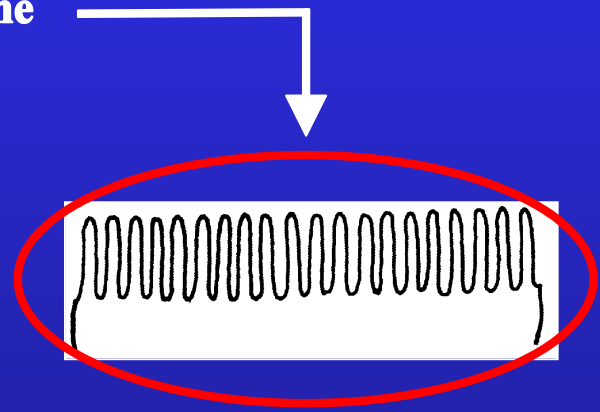




Zambonino Infante et al., 1997

Location of enzymes within the enterocyte





Brush border purification

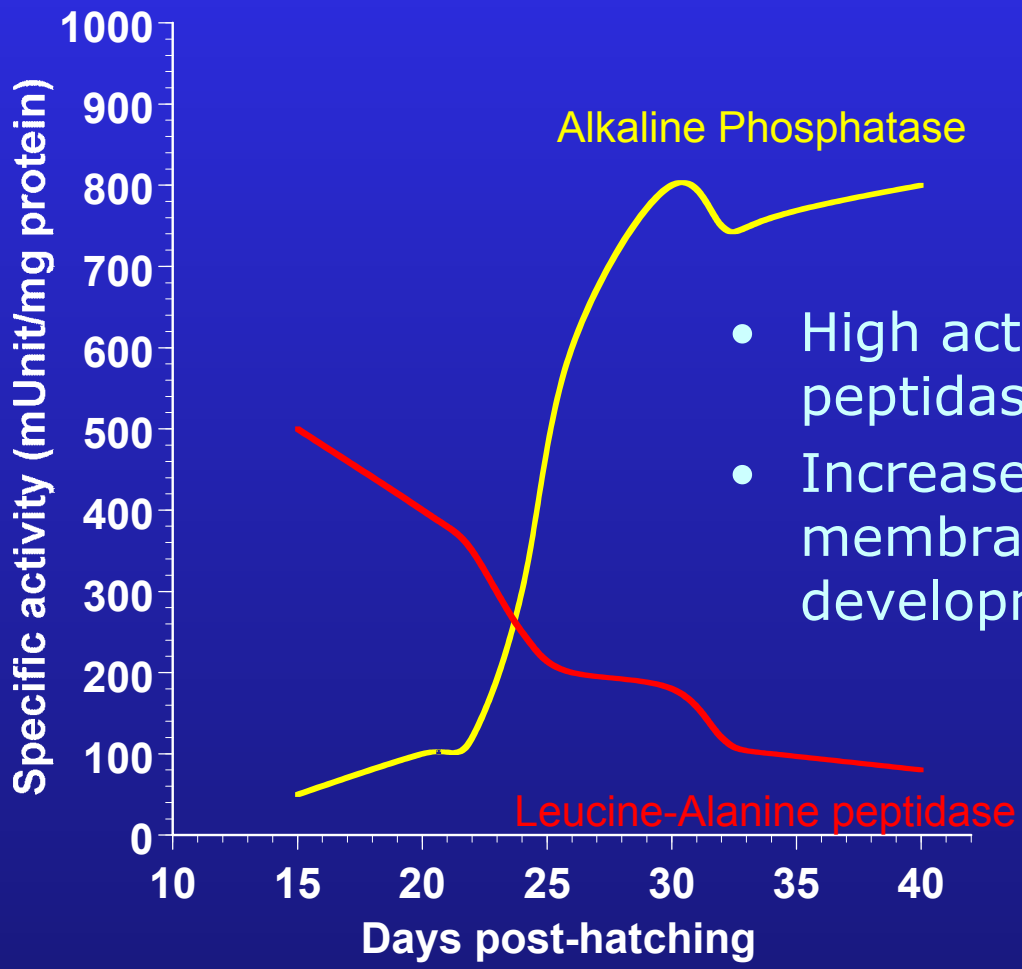
→ **ASSAY OF BBM ENZYMES** 1

Enzymes linked to the cell membrane

→ **ASSAY OF cytosolic ENZYMES** 2

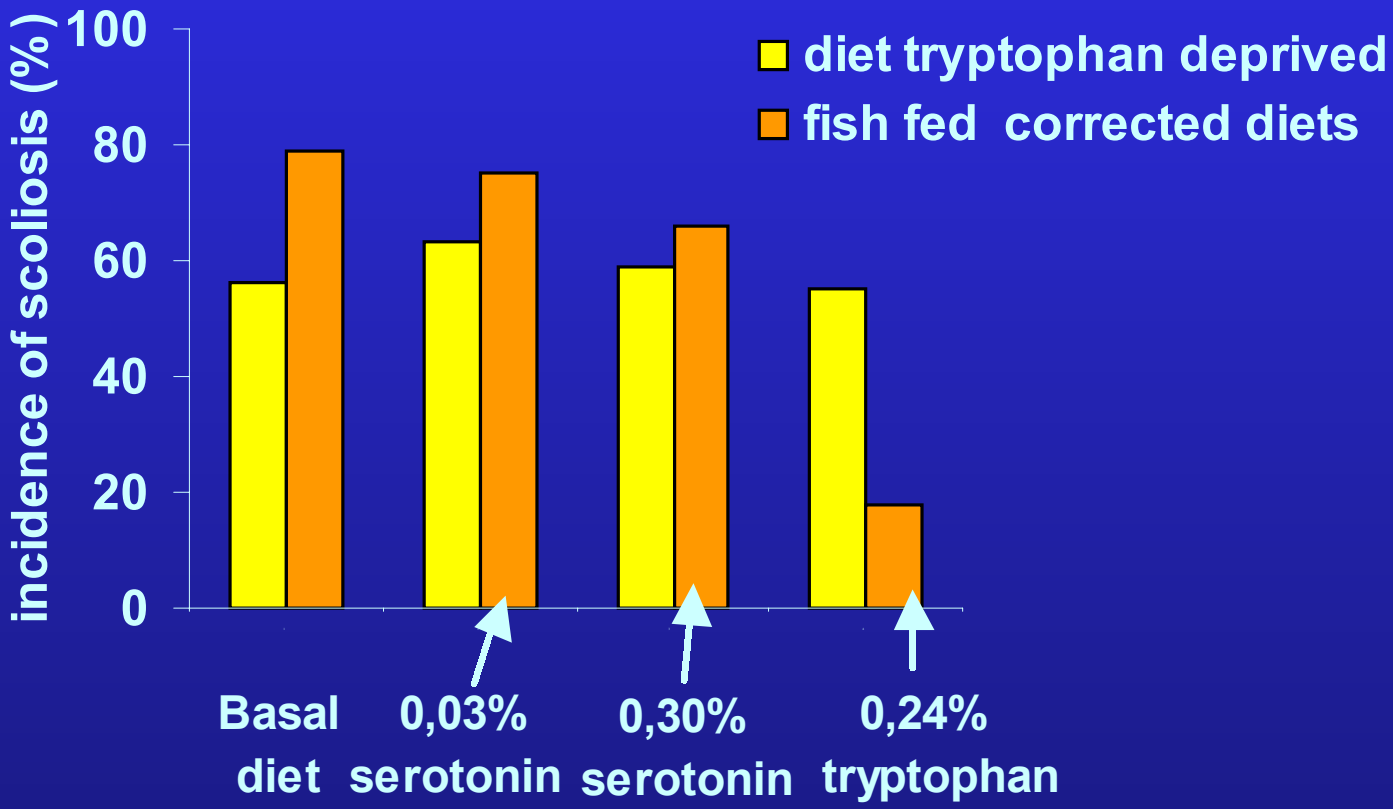
Enzymes acting in the cytosol area

Changes in intestinal enzymatic activities during sea bass larvae development



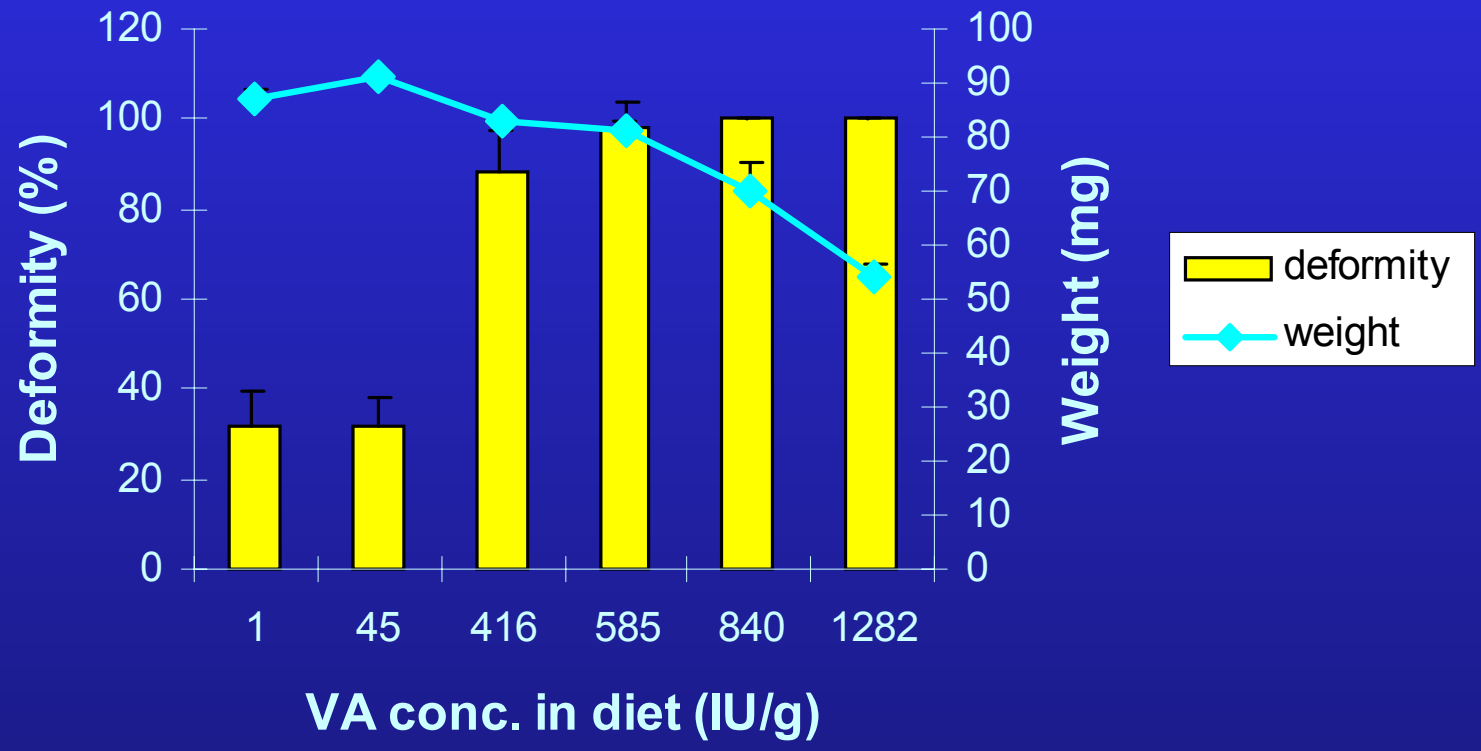
- High activity of cytosolic peptidases during early stages
- Increase of brush border membrane enzyme during development.

Effect of dietary tryptophan on scoliosis incidence in Chum salmon



Akiyama et al., 1986

Effect of vitamin A on flounder (*Paralichtys olivaceus*) development

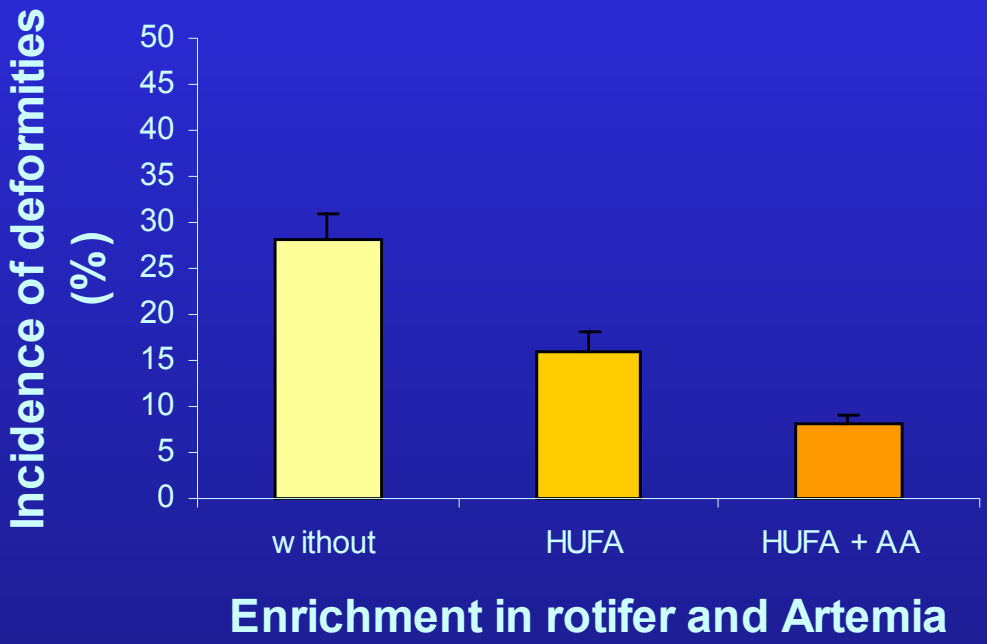


Dedi et al., 1995

Effect of vitamin A on pigmentation

- Dietary incorporation of vitamin A, associated to PL (mainly PC) and DHA is essential for reducing pigmentation default in flatfish (Kanazawa, 1993)
- Color abnormality can be reduced by feeding flounder with rotifers enriched with high vitamin A level (50 000 IU/liter). But this concentration causes severe bone deformities (Miki et al., 1990)

Effect of ascorbic acid on larval quality in milkfish (*Chanos chanos*)



- Lower opercular deformities in fish fed rotifer and Artemia enriched with AA
- Neither growth nor survival was improved with this AA enrichment

Gapasin et al. 1998

Conclusions

- Several dietary components affect quality in fish larvae
- Diet composition from first feeding is determining
- Knowledge on the effect of dietary components on larvae quality will be improved by the use of formulated diets