



Impact of some dietary components on rainbow trout development

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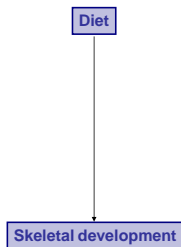


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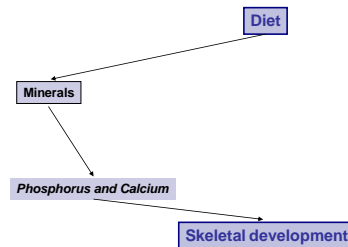
- FINE FISH project
Improving sustainability of European fish aquaculture by control of malformations
- Malformations
 - Skeletal deformities (spinal column, caudal fin, skull and operculae) ⇒ most important in terms of economy
 - Malformations of heart/other internal organs ⇒ less well recognized
- Numerous potential causes of skeletal deformities:
 - Three focus areas of research: rearing temperature, tank environment and nutrition



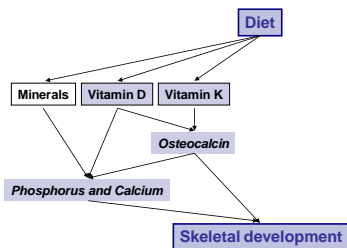
Impact of some dietary components on skeletal development in fish



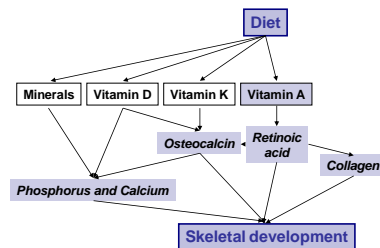
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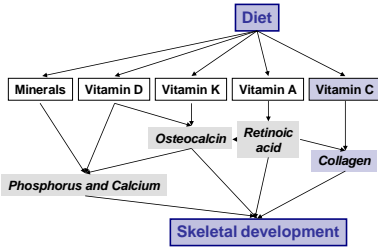
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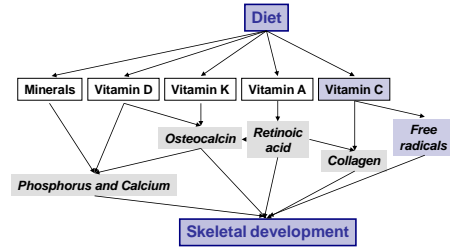
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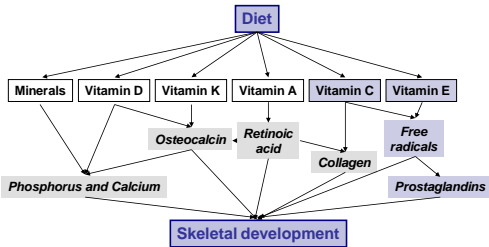
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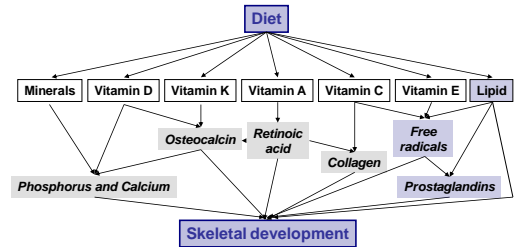
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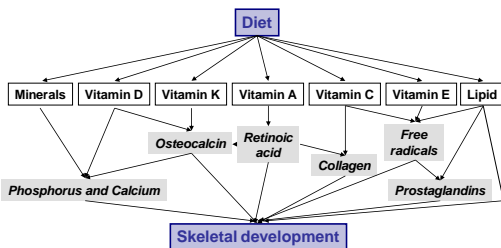
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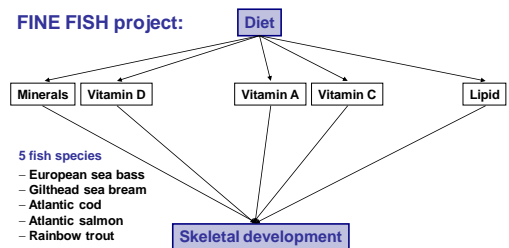
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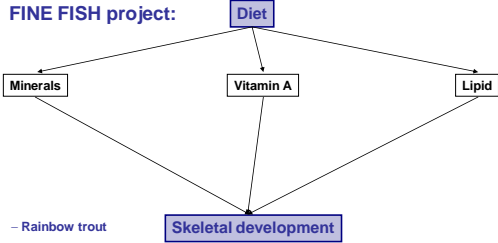
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Impact of some dietary components on rainbow trout development

- FINE FISH project:
- **Minerals (phosphorus and calcium)**
 - Involved in the development/maintenance of skeletal system
 - In fish feeds, availability can vary (plant/marine ingredients)
 - ⇒ important to define their impact on the conformation of fish
 - **Vitamin A**
 - Vitamin required for reproduction but its metabolite, retinoic acid, is highly teratogenic
 - ⇒ important to define the right level in broodstock diets
 - **Lipid**
 - Significant amounts in skeletal tissues including collagen which are particularly susceptible to lipid peroxidation
 - ⇒ important to define their impact on the conformation of fish

Impact of dietary minerals on rainbow trout development

- FineFish project: identify critical components of dietary minerals in juvenile rainbow trout
- ➔ Assess the influence of dietary P and Ca levels on bone mineralization
- FineFish experimental design

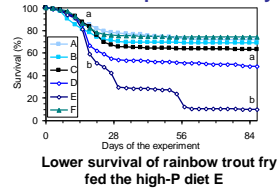
6 diets:

Diet	A	B	C	D	E	F
Available P	-	0.4	0.8	1.2	1.6	0.8
Available Ca	1	1	1	1	1	-

From first-feeding onwards, 12-week growth trial at 17 °C

Impact of dietary minerals on rainbow trout development

- Results: impact of dietary phosphorus level



Impact of dietary minerals on rainbow trout development

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Lower skeletal mineralization in fish fed low-P diet A

Impact of dietary minerals on rainbow trout development

- Results: impact of dietary phosphorus level

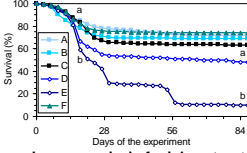


Higher incidence of abnormalities with irregular placement of vertebrae and twisted arches in fish fed low-P diet A

Lower skeletal mineralization in fish fed low-P diet A

Impact of dietary minerals on rainbow trout development

Results: impact of dietary phosphorus level



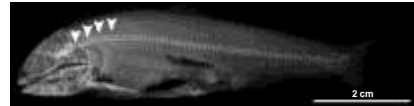
Lower survival of rainbow trout fry fed the high-P diet E Lower skeletal mineralization in fry fed low-P diet A

Both dietary deficiency and excess of P are detrimental to rainbow trout fry development

Impact of dietary minerals on rainbow trout development

Results: impact of dietary calcium level

- No effect on growth performance and whole body composition
- Effect on bone mineralization was less clear: Ca deficiency appears to exert some delay in ossification processes with an impact on the vertebral column morphology



Kyphosis in the cranial region with smaller vertebrae in fish fed low-Ca diet F

Impact of dietary minerals on rainbow trout development

Conclusion

Importance of dietary mineral supply for adequate skeletal mineralization

Special attention should be paid to the level and availability of phosphorus in the formulation of diets for normal vertebral development during early ontogeny of rainbow trout (~1% available P)

Impact of dietary vitamin A on rainbow trout development

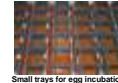
FineFish project: assess the influence of vitamin A level in broodstock diets on trout fry development

FineFish experimental design

3 different dietary supplementations of vitamin A as retinyl acetate

Dietary supplementation	Dietary level
0 IU/g diet in A1	20 IU/g in A1
20 IU/g diet in A2	40 IU/g in A2
200 IU/g diet in A3	200 IU/g in A3

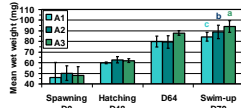
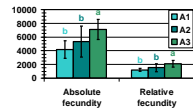
6-month trial (prior to spawning) at 7 1 C



Small trays for egg incubation

Impact of dietary vitamin A on rainbow trout development

Results



Best fecundity, early growth and potential of muscle development with the highest level of vitamin A

Very low level of external malformations (<0.5%) in all groups of rainbow trout fry (approximately 5g)

Low impact of broodstock diets on skeletal development of trout fry (small delay in ossification processes in A3 group)

Impact of dietary vitamin A on rainbow trout development

Conclusion

High dietary level of vitamin A is recommended for rainbow trout broodstock (~ 200 IU/g)

beneficial for reproduction and larval growth (no effect on skeletal development)

Level of retinoic acid, the active metabolite of vitamin A, appears to be well controlled in eggs of rainbow trout (no difference between dietary groups contrary to other retinoids)

Impact of dietary lipids on rainbow trout development

Previous studies have highlighted the influence of dietary lipids on the incidence and development of malformations

- FineFish project: assess the impact of dietary lipids (phospholipid content and level of peroxidation) on rainbow trout fry development
- FineFish experimental design

6 diets:

Diet	Diet	R1	R2	R3	R4	R5	R6
Phospholipid source	Soybean lecithin	6%	6%	-	-	-	-
	Egg lecithin	-	-	6%	6%	-	-
	Soybean oil	-	-	-	-	6%	6%
Level of peroxidation	Fresh fish oil	12%	-	12%	-	12%	-
	Oxidised fish oil	-	12%	-	12%	-	12%

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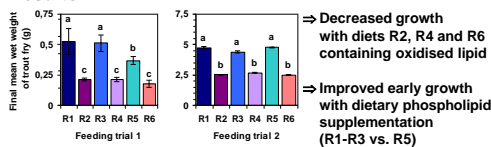
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Impact of dietary lipids on rainbow trout development

- FineFish experimental design
- From first-feeding onwards or 8 weeks after this stage
Two 4-week feeding trials at 17 °C

Results



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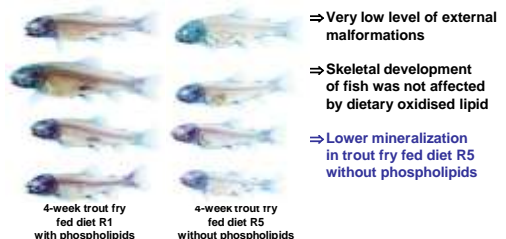
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Impact of dietary lipids on rainbow trout development

Results



Impact of dietary lipids on rainbow trout development

- Conclusion

Special attention should be paid to the **control of lipid peroxidation in fish feeds** for normal growth of trout fry

⚠ if feeds contain large amounts of polyunsaturated fatty acids
⇒ correct supply of antioxidants

Importance of **dietary phospholipid supply** for early growth and adequate skeletal mineralization

phospholipid requirement for lipid absorption in early developmental stages
(ratio dietary phospholipid/neutral lipid = 1/2)

Impact of some dietary components on rainbow trout development

- Conclusion

→ nutritional components affect skeletal development

Compared to other fish species, in rainbow trout fry the impact of nutritional components on the development of external malformations is quite low

→ “plasticity” of rainbow trout to different nutritional conditions

→ at first-feeding, rainbow trout is well developed