Amylase polymorphism affects growth in the cupped oyster *Crassostrea gigas*

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Ifremer

Non neutrality of amylase polymorphism

. amylase genotype ⇔ food preference (Crustacean)

. amylase genotype ⇔ activity of amylase enzyme (Drosophilae)

. amylase polymorphism affects growth & feed conversion mainly via the specific amylase activity (chicken)

↳ selection on amylase marker may improve growth, feed efficiency performance

Digestive processes & growth in bivalves

. assimilation = a main parameter that affects growth variability

[+ feeding rate, allozyme heterozygosity for metabolic pathway, aneuploidy]

. assimilation = mainly controlled by ingestion (food level) and digestive enzymes, especially α-amylase (starch digestion) (enzyme abundance & performance)

. effect of food level on specific amylase activity and amylase mRNA level

in *Crassostrea gigas*…

- 2 amylase genes A & B coding for 2 mRNAs
- 6 (gene A) and 4 (B) PCR-RFLP alleles on the more variable sequence of the mature protein

Aims:

- test the non-neutrality of the amylase polymorphism in oyster
  - look for some relationships between amylase polymorphism and phenotypes

"gestion intégrée" i.e. rational stock control: improve productivity with respect for coastline

"the strong increase of the french production since 1972 was correlated to a decrease of productivity related to a limiting food capacity of the environment"

in situ design

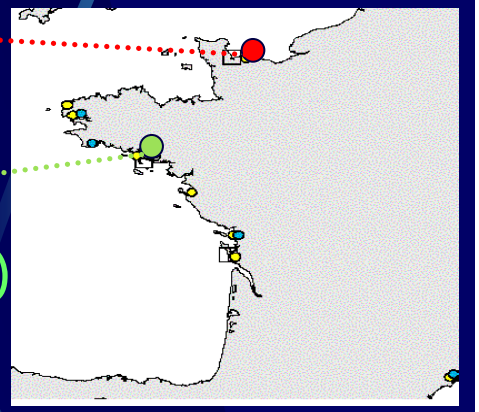
5 bi-parental *C. gigas* families
bred to be polymorph at the 2 PCR-RFLP amylase markers

reared over one year under
standard culture conditions

in 2 French aquaculture areas

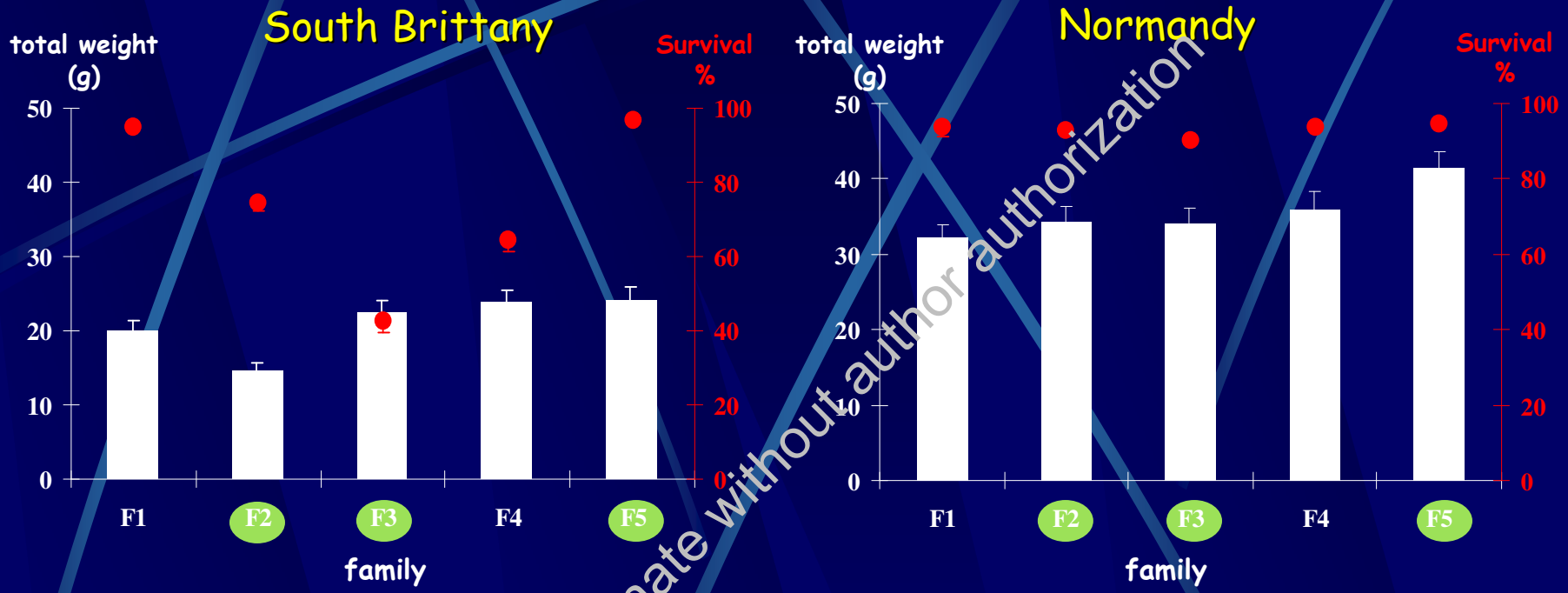
. Baie des Veys
(Normandy)

. Auray
(South Brittany)



. Genotyping (PCR-RFLP on both markers)
. Individual measurement of weights
. Analysis of survival

Family performances



↳ *Genetic & Environmental effects on growth*

- weights (total & meat)
  - . Normandy > Brittany
  - high differences between families especially in Brittany

Baie des Veys: high-growing site for oyster aquaculture (chlorophyll a = 4.9 >> 3.3 µg/L in Auray)
high resource abundance ➔ high food consumption/food conversion efficiency ➔ high energy allocation for oyster

Genotype performances (e.g. within family 2)

- significant differences of weights between amylase genotypes within 2 families (2 & 3)

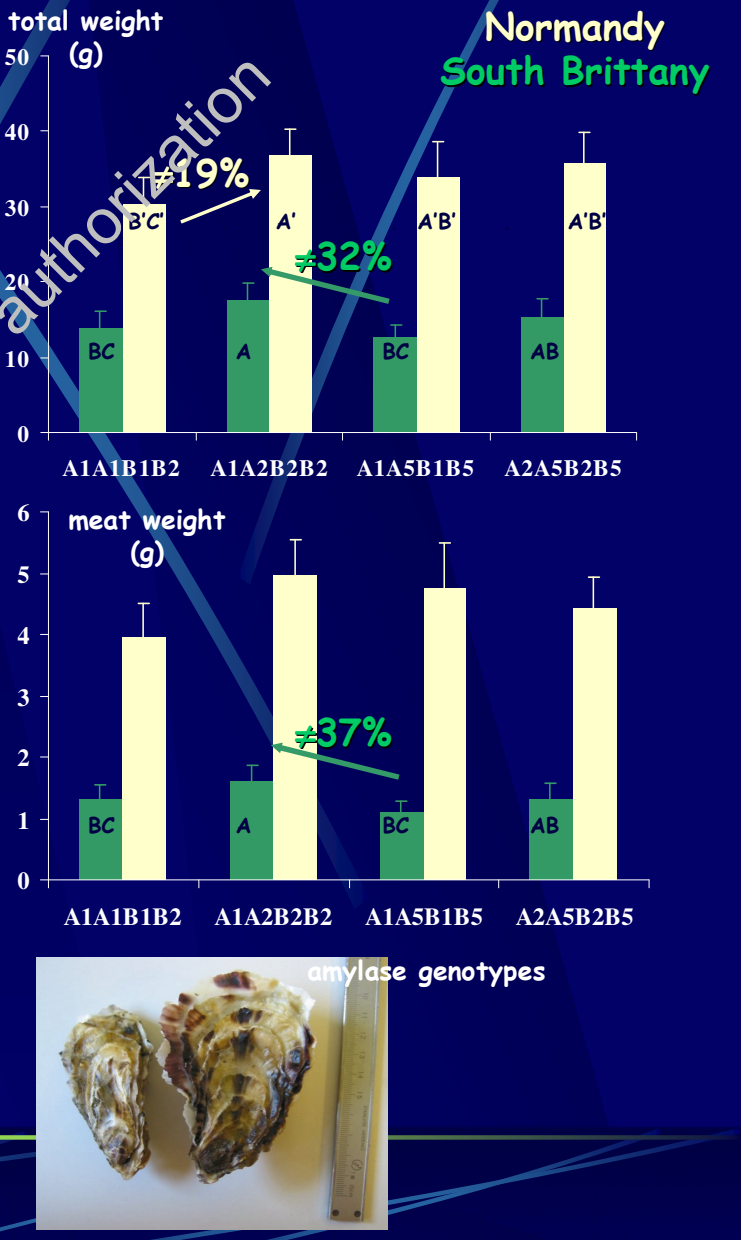
↳ *amylase polymorphism ⇔ growth*

- maximal difference between A1A2B2B2 - A1A5B1B5
  in Brittany 32% total weight / 37% meat wet weight
  in Normandy smaller, max = 19%

↳ *amylase polymorphism affects growth especially under the weak food level (limiting trophic conditions?)*

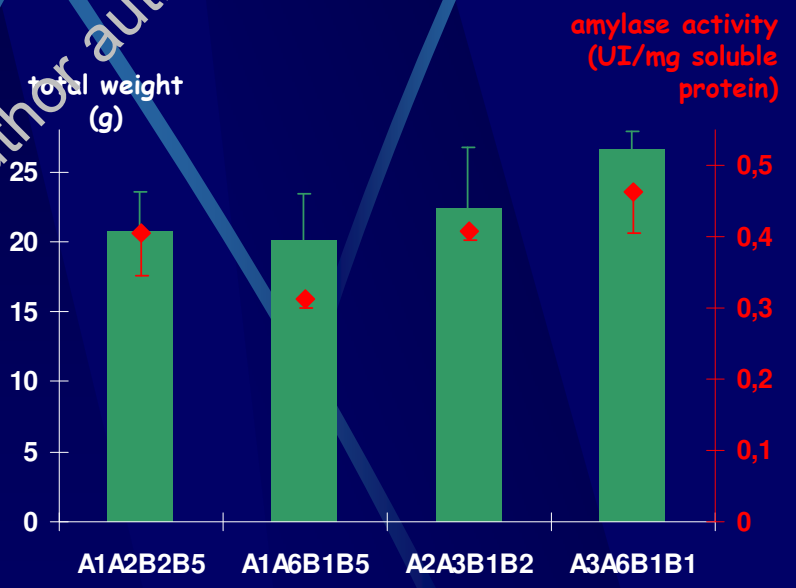
- no differences of survival of genotypes between T0 & T1 (χ^2)

↳ *differences of estimated daily yield between genotypes (10%)*



genotype ⇔ growth via amylase enzyme ?

enzymatic assays for α-amylase of each genotype collected at T1 (winter) in South Brittany (where significant differences of weights were the highest between genotypes)



- significant differences of specific amylase activity between genotypes

↳ *amylase polymorphism ⇔ amylase activity*

- positive correlation between amylase activity and total weight

↳ *specific amylase activity could partly explain the weight difference between amylase genotypes in this experiment*

4 main conclusions

1) correlation between amylase polymorphism and growth (and consequently yield) in the Pacific cupped oyster

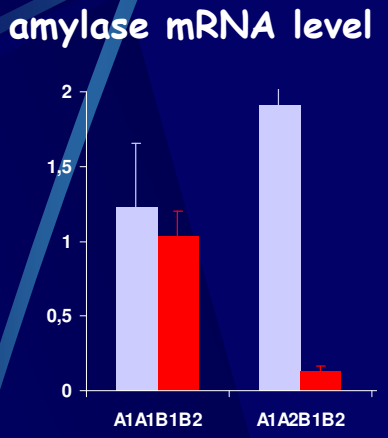
2) putatively expressed via the specific amylase activity
(in this *in situ* experiment)

3) depends on the environment (under food limitation)

4) interest in using the amylase markers for selective breeding program in oyster

Perspectives: towards physiological explanation…

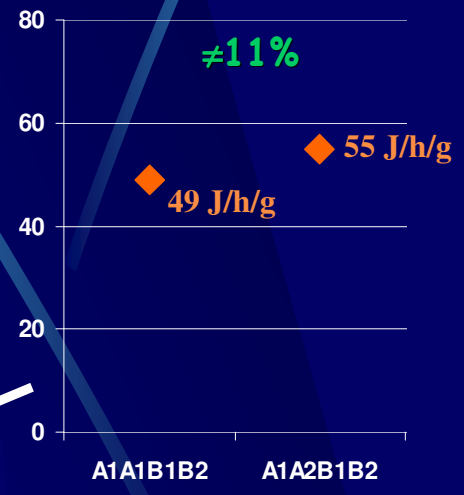
investigation into oyster digestive parameters (i.e. absorption, assimilation) and amylase parameters (mRNA level, activity) depending on amylase polymorphism and food abundance



enzymatic properties (activity, Km)

?

≠32%



due to variations in absorption efficiency and ingestion rate

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Ifremer

Aquaculture of *Crassostrea gigas*

. the Pacific oyster *C. gigas* = the main cultivated cupped oyster species in the world

. the strong increase of the french production since 1972 was correlated to a decrease of productivity related to a limiting food capacity of the environment

> a major interest in aquaculture

knowledge of feeding strategies & digestive capacities displayed by bivalves under different food conditions & effects on phenotype (growth)

↳ "gestion intégrée" i.e. rational stock control: improve productivity with respect for coastline