

**Jorge Dias et al.**

**CIMAR-CCMAR**

Aquaculture Research Group  
[jorqedias@ualg.pt](mailto:jorqedias@ualg.pt)

**CIMAR-CIIMAR**

LANUCE-ICBAS, UP.  
Zootechnical Dept., UTAD

**SORGAL, S.A.**

SEACASE Project  
Sustainable extensive and semi-  
intensive coastal aquaculture in  
Southern Europe

STREP Project FPG-2005-SSP5A  
European Commission

*Diet formulation for sustainable fish  
farming in ponds & lagoons:*

*Maintain performance  
& reduce soluble wastes*



## Semi-intensive systems need...

To develop effective tools for higher:

- Competitiveness
- Productivity
- Profitability



Quality is an important aspect, but added value  
can also be associated to the term  
**ENVIRONMENTAL FRIENDLY**

**Effectively minimizing** environmental impacts

**Improving public perception** of products

## Technical improvements to optimise production

**Feed can account for 30-45% of total operational costs of a fish farm**

*Development of a cost efficient **eco-friendly feed** to be used in semi-intensive fish farming systems*

- *by reducing waste and nutrient loads to the environment*
- *by reducing the pressure on natural fish stocks exploited for fish meal and oil*



## Some basic assumptions that we used...

Feeds commonly use in semi-intensive farming for bream and bass **should be medium-energy density** (*not high-energy*)

The **CONTROL** formula **should be practical** (*current commercial formulas for bream and bass have about 35-40% of marine-derived proteins*)

The **EXPERIMENTAL** formulas **should also be practical** (*availability of ingredients, costs and technological constraints - extrusion*)

## How we proceed within the SEACASE project...

### 3 Trials with gilthead seabream

- **Trial 1:** to “screen” and assess the feasibility of different **eco-friendly** formulations (5) in sustaining a competitive performance during the grow-out stage
- **Trial 2:** validate the efficacy of a chosen **eco-friendly** formulation during the juvenile phase
- **Trial 3:** validate the efficacy of a chosen **eco-friendly** formulation in a pilot-scale trial

## TRIAL 1: Experimental protocol

*Dias et al. 2009. Aquaculture*

### Homogenous groups of 50 seabream

**IBW: 180 g**

**FM** - 32% FM & 100% FO

**PP40FO** - 40% replacement of FM & 100% FO

**PP40VO** - 40% replacement of FM & 65% VO

**PP60FO** - 60% replacement of FM & 100% FO

**PP60VO** - 60% replacement of FM & 65% VO

Diets tested in triplicate over 12 wks  
Hand fed to satiety, 3 meals/day

**PP – Plant proteins**  
Soybean meal 48  
Peas concentrate  
Corn gluten meal  
Wheat distiller's grains

**VO – Vegetable oils**  
Soybean oil  
Rapeseed oil  
Linseed oil



## Criteria under evaluation

After 12 weeks →



Ice & Water slurry  
(common industry practice)

### Zootechnical evaluation

- Fish growth (weight gain, growth rate,...)
- Feed consumption (feed intake, FCR,...)
- Apparent digestibility of nutrients (CCMAR-CIIMAR)
- Soluble nitrogen and phosphorus excretion

### Sampling

- Whole fish for body composition (CCMAR-CIIMAR)
- Dorsal muscle for fat content and fatty acid profile
- Dorsal muscle for susceptibility to oxidation (CCMAR)
- Fillets for texture analysis (INRB-IPIMAR)



## Results: growth performance

Treatments	FBW (g)	DGI	Feed intake (%IBW/day)	FCR	PER
FM	300.4	1.16	1.00	1.40 a	1.46 c
PP40FO	300.8	1.16	1.01	1.40 a	1.41 b
PP40VO	291.8	1.08	0.94	1.45 ab	1.37 b
PP60FO	293.0	1.10	0.90	1.43 ab	1.38 b
PP60VO	291.6	1.09	1.04	1.59 b	1.22 a

- 40% FM replacement has no effect on growth performance
- 60% replacement of FM (with 100% fish oil) has no detrimental effect on growth and FCR
- 65% replacement of fish oil has a negative effect on FCR and PER, **but only when associated to a simultaneous 60% replacement of FM**

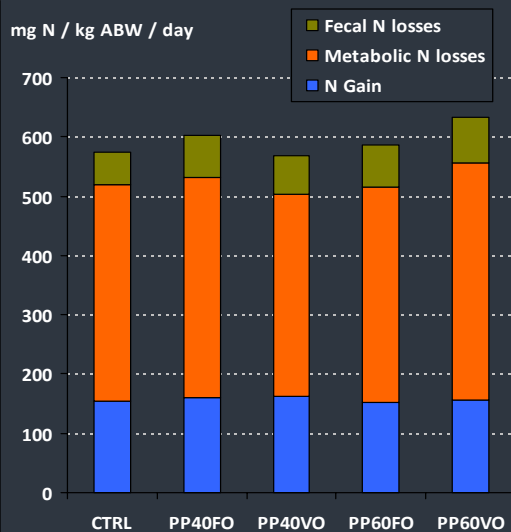
## Results: whole-body composition

Treatments	Moisture % DM	Protein % DM	Fat % DM	Phosphorus % DM	Energy kJ/g DM
FM	37.6	46.0 a	42.8	1.62 a	26.9
PP40FO	37.2	46.8 ab	41.9	1.64 a	26.5
PP40VO	37.7	47.8 b	41.1	1.62 a	26.4
PP60FO	37.0	47.4 b	41.4	1.64 a	26.5
PP60VO	37.2	47.5 ab	40.4	1.70 b	26.8

Whole-body composition of seabream was little affected by diets

High levels of vegetable ingredients did not affect ADC values of dry matter, protein and phosphorus (data not shown)

## Results: protein deposition

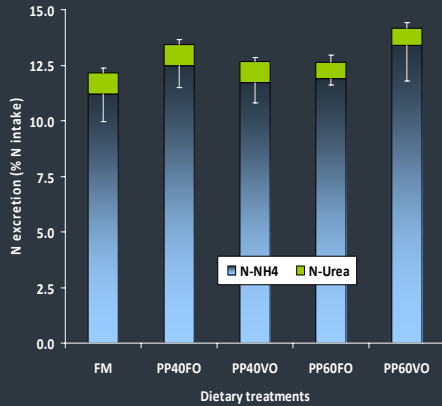


Expressed as daily gain (a criteria less influenced by FCR), the high replacement levels of both fishmeal and fish oil have no effects on protein accretion

*Similar metabolic efficiency on the use of protein*

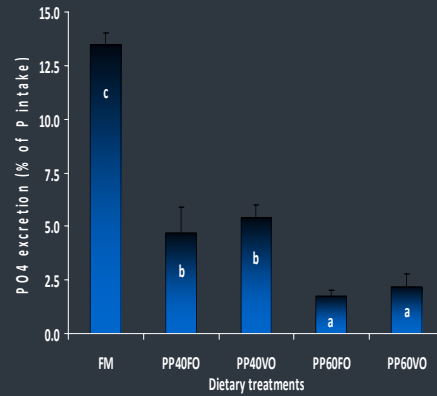
## Soluble nitrogen and phosphorus excretion

Fishmeal replacement by plant-proteins had no major effect on total N-ammonia and N-urea losses



Soluble phosphorus excretion was significantly reduced by the use of plant-protein rich diets

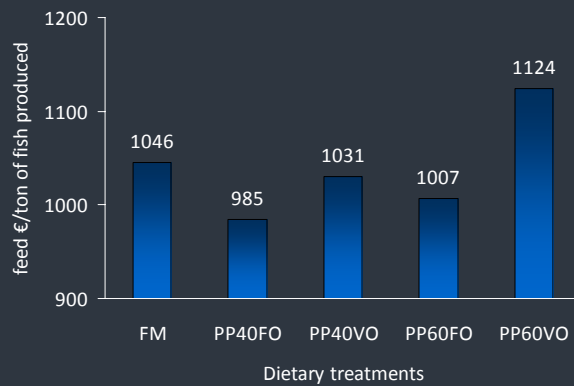
*Lower environmental impact*



## Results: economical perspective

Data from 2008

Current high FM prices (1200 €/ton) make it even more interesting



Economical gains can be achieved without compromising growth performance

- But FCR is the driving factor for economical returns
- Feeding management is a key issue

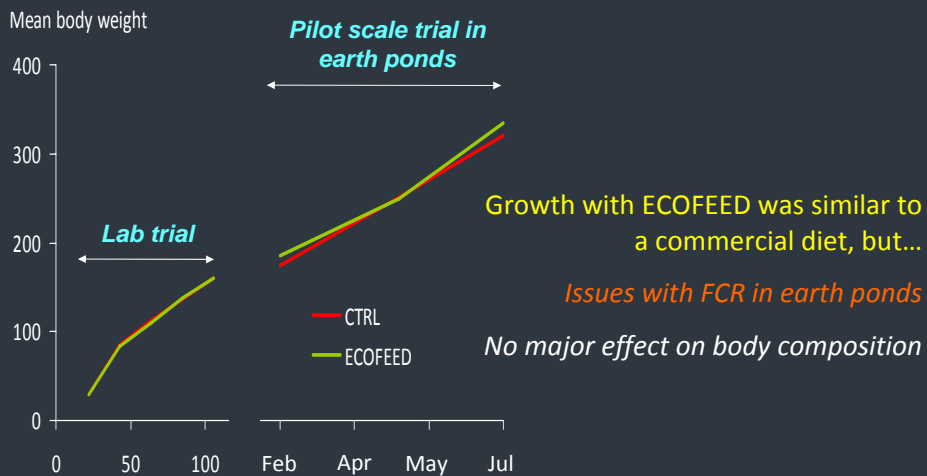


# Main conclusions from trial 1

## Based on tested formulations:

- **Fishmeal replacement up to 60% - no risk for growth**
  - Growth performance of gilthead seabream during the grow-out phase can be sustained by a practical diet containing as little as a 12.5% level of marine-derived proteins
  - Such formulation has no detrimental effects on nitrogenous and phosphorus fecal losses and reduces significantly soluble phosphorus excretion
- **Fish oil replacement by vegetable oils should be lower than the tested level of 65% to avoid a FCR deterioration**
  - Recommended replacement level: 30 - 40%

# Validation of the ECOFEED formulation



LANUCE – CIIMAR

*Luísa Valente, Pedro Borges, Cláudia Escórcio,  
Paulo Vaz-Pires, Paulo Rema*



INRB - IPIMAR

*Hugo Ferreira, Pedro Pousão, Emília Cunha,  
Amparo Gonçalves, Leonor Nunes, Narcisa  
Bandarra*

AQUAGROUP - CCMAR

*Rita Colen, Vera Rodrigues, Helena Teixeira,  
Elisabete Matos, André Santos, Sónia Fava,  
Benjamín Costas, Ana Ramalho, Sofia Engrola,  
Luís Conceição, Maria Teresa Dinis*

SORGAL S.A.

*Tiago Aires*

*Thank you all for your  
great contribution!!!*

