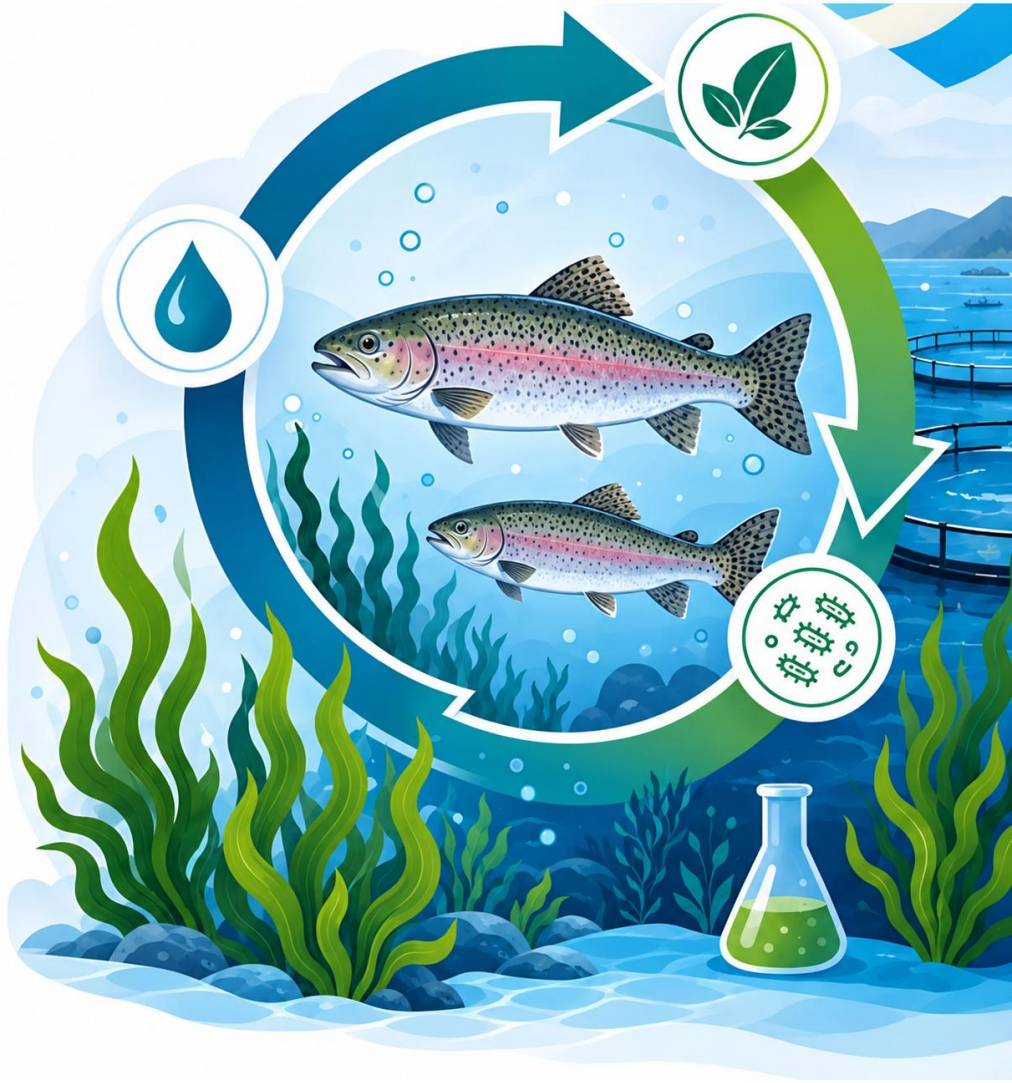
Impact of alternative ingredients on rainbow trout productivity and welfare



SAFE Online Workshop

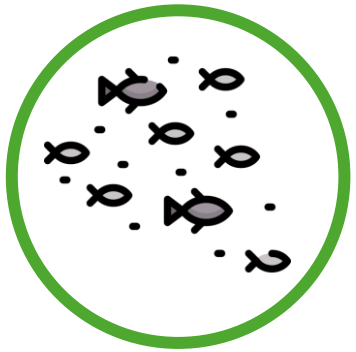
Beyond technical success: from innovation to implementation in sustainable aquaculture

Diogo Amaral, Gabriela Lopes, Catarina Oliveira, Thais Cavalheri, Alex Wan, Helena Peres and Rodrigo Ozorio

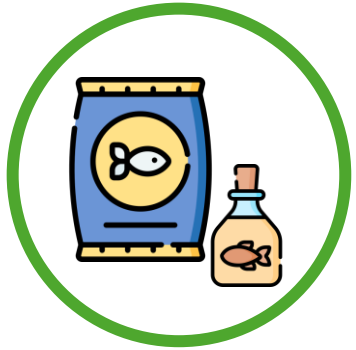
Fundação para a Ciência e a Tecnologia
REPÚBLICA PORTUGUESA
SAFE
European Commission
Funded by the European Union

Challenges in aquafeeds development

Small pelagic fish



Fishmeal and fish oil



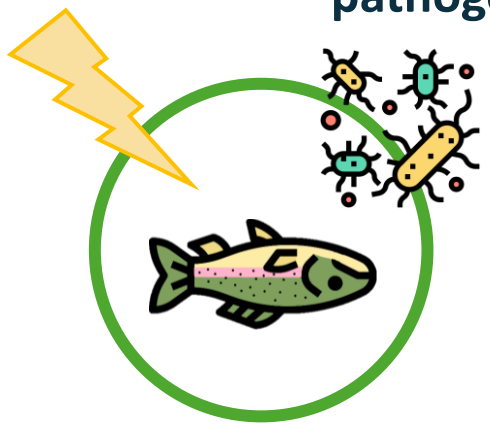
- Increasing cost
- Ethical and sustainability concerns

Vegetable meals and oils



- Several anti-nutritional factors
- Food-feed competition

Opportunistic pathogens



- Production loss
- Negative attitude towards antibiotics

- **Develop alternative protein and lipid sources**
- **Develop innovative solutions to enhance fish immunity**

Novel protein and lipid sources

Mealworm *Tenebrio molitor*



Redworm *Eisenia fetida*

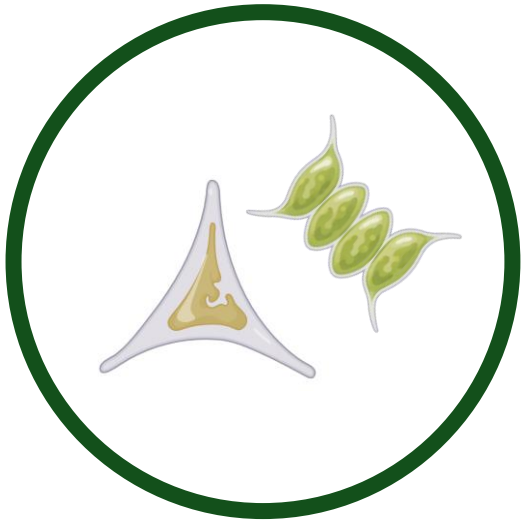


- **Favorable protein and lipid contents, and essential amino acid profiles comparable to fishmeal**
- **Some anti-nutritional factors, such as high levels of chitin**

Novel bioactive compounds sources

Microalgae *Phaeodactylum tricornutum*
and ***Scenedesmus* spp**

Industrially relevant microalgae rich in o**mega-3 polyunsaturated fatty acids and bioactive compounds**

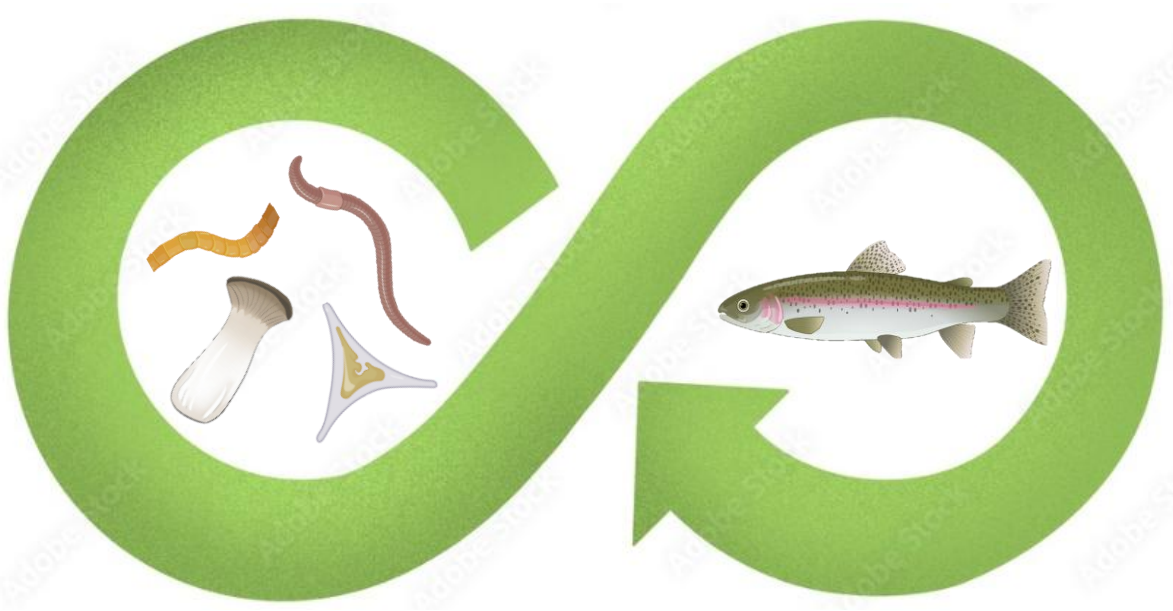




Oyster mushroom *Pleurotus ostreatus*

Fungal biomasses are a proven source of **immunostimulants** such as **lectins, terpenoids and β - Glucans**

Objectives

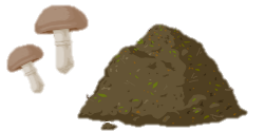


Evaluate the effects of dietary inclusion of the ingredients in **zootechnical productivity and physiology** of rainbow trout



Mealworm

SMS TM
Partially reared on spent mushroom substrate



CC TM
Fully reared on cereals and brans



CTRL	SMS12.5	SMS25	CC12.5	CC25
20% Fishmeal	10% Fishmeal 12.5% SMS TM	25% SMS TM	10% Fishmeal 12.5% CC TM	25% CC TM



Growth trial
Feeding: 2 times / day; *ad libitum*
Duration: 8 weeks

Experimental diets

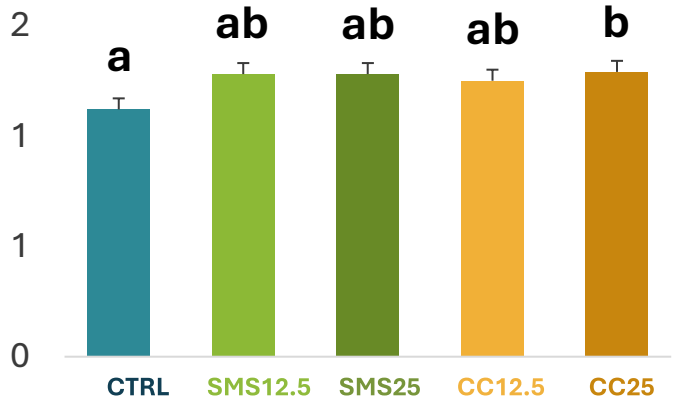


Growth performance and feed utilization

No significant differences were observed on **final body weight and daily growth index**

Voluntary feed intake was reduced in the SMS25 and CC25 treatments

Feed efficency



Initial body weight: 11g

Avg. Final body weight: 84g





Mealworm

Experimental diets

CTRL	SMS12.5	SMS25	CC12.5	CC25
20% Fishmeal	10% Fishmeal 12.5% SMS TM	25% SMS TM	10% Fishmeal 12.5% CC TM	25% CC TM



Haematological parameters

No significant differences were observed on **haematocrit and haemoglobin levels**

Innate immunity parameters

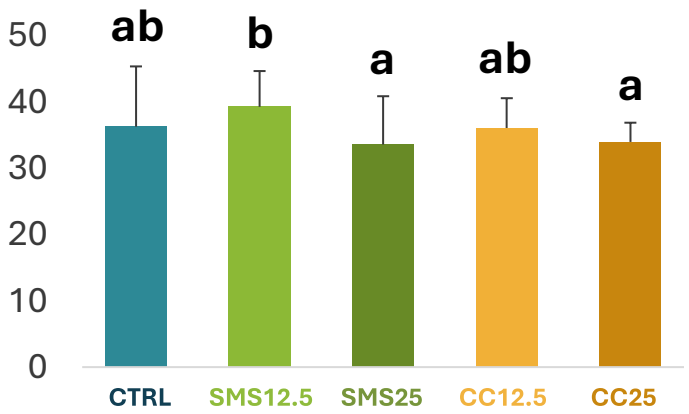
No significant differences between mealworm types were observed on **peroxidase, lysozyme, protease, anti-protease** activities

Hepatic oxidative stress

No significant differences were observed on **lipid peroxidantion and redox status**

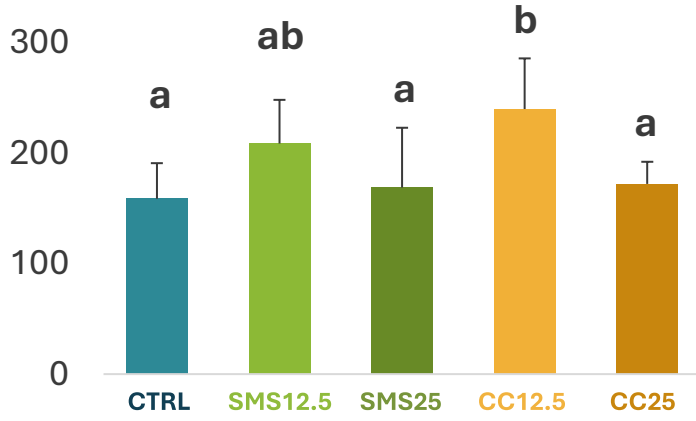
ACH50

(ACH50 U.ml^{-1})



Catalase

(µmol.min..mgProtein^{-1})





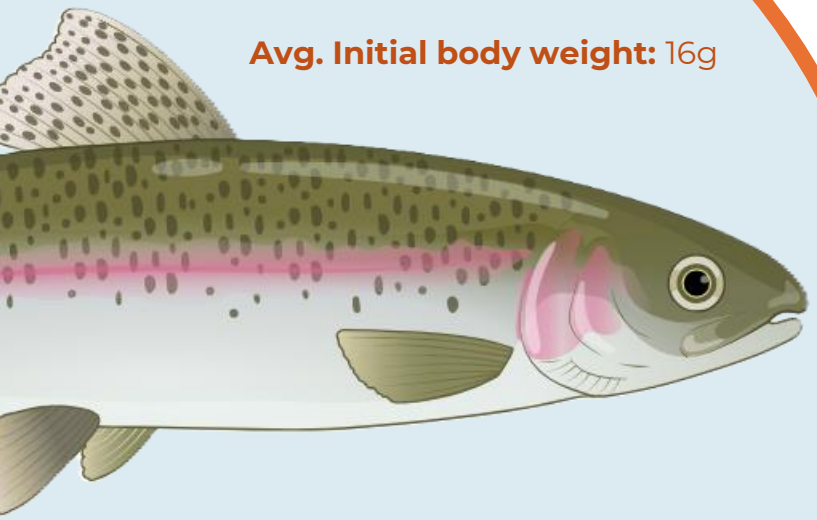
Redworm

Growth trial

Feeding: 2 times / day; *ad libitum*
Duration: 6 weeks

Experimental diets

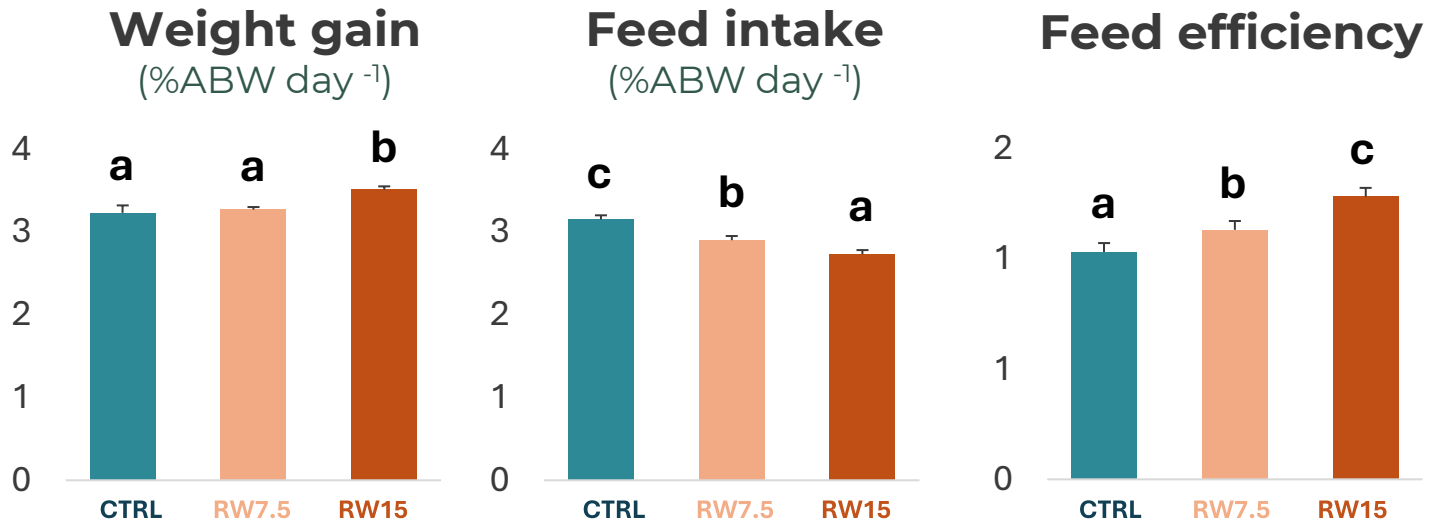
CTRL	RW7.5	RW15
15% Fishmeal	7.5% Fishmeal 7.5% RW	15% RW



Avg. Initial body weight: 16g

Growth performance and feed utilization

No significant differences were observed on **survivability**





Redworm

Experimental diets

CTRL	RW7.5	RW15
15% Fishmeal	7.5% Fishmeal 7.5% RW	15% RW



Innate immunity parameters

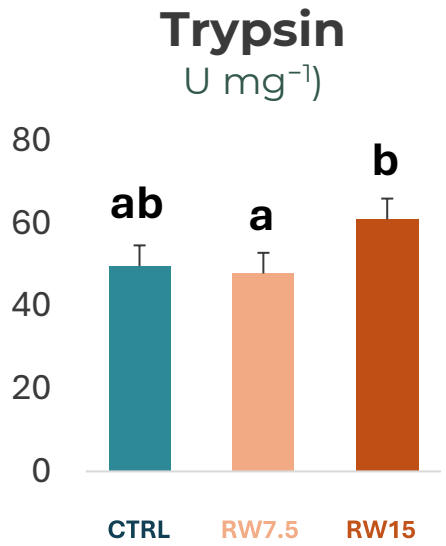
No significant differences were observed on **peroxidase, lysozyme, protease, anti-protease and ACH50** activities

Digestive enzymes activities

No significant differences were observed on **amylase and lipase** activities

Haematological parameters

No significant differences were observed on **lipid peroxidation, activities of antioxidant mechanisms** and **redox status**





Mushroom stems

Experimental diets

CTRL	MS0.6	MS3	MS6
0% MS	0.6% MS	3% MS	6% MS

Growth trial

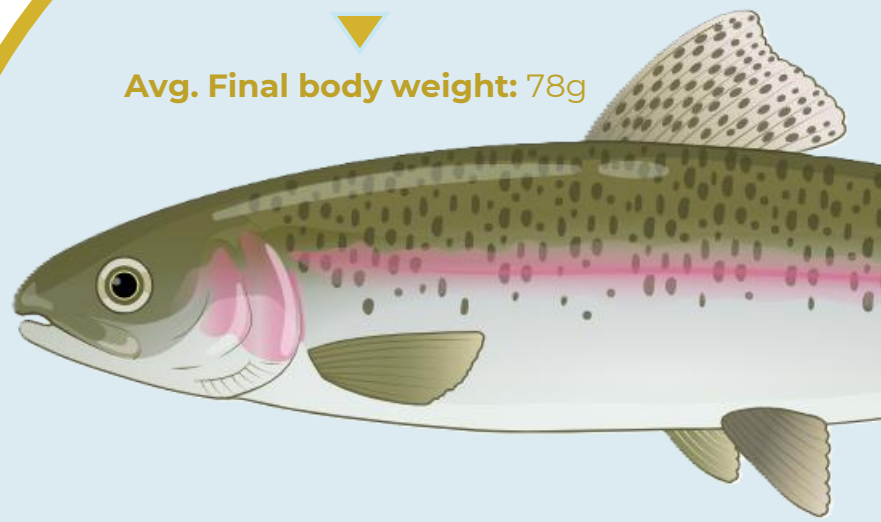
Feeding: 2 times / day; *ad libitum*
Duration: 6 weeks

Growth performance and feed utilization

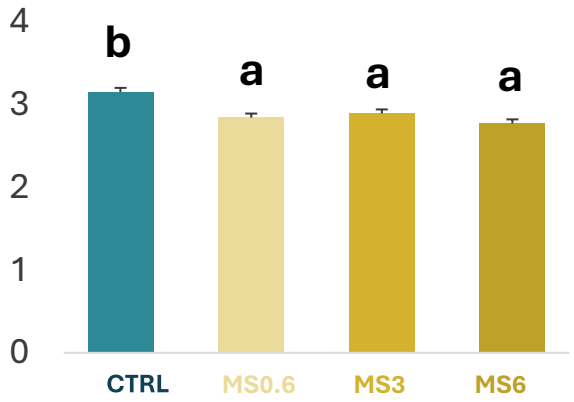
No significant differences were observed on **growth performance** and **survivability**

Avg. Initial body weight: 16g

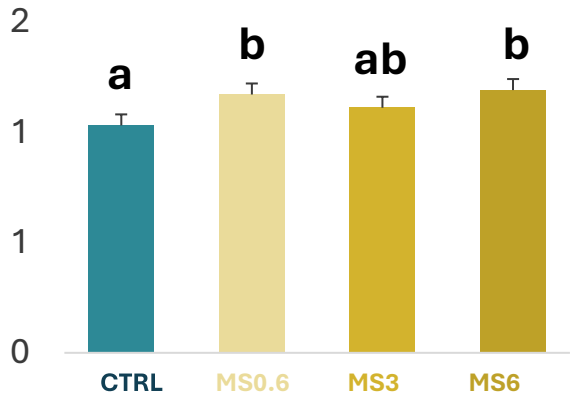
Avg. Final body weight: 78g



Feed intake
(%ABW day $^{-1}$)



Feed efficiency





Mushroom stems

Experimental diets

CTRL	MS0.6	MS3	MS6
0% MS	0.6% MS	3% MS	6% MS

Haematological parameters

No significant differences were observed on **haematocrit** and **haemoglobin levels**

Innate immunity parameters

No significant differences between mealworm types were observed on **peroxidase, lysozyme, protease, anti-protease** and **ACH50** activities

Hepatic oxidative stress

No significant differences were observed on **lipid peroxidation, activities of antioxidant mechanisms** and **redox status**



Microalgae

Phaeodactylum tricornutum (PT)

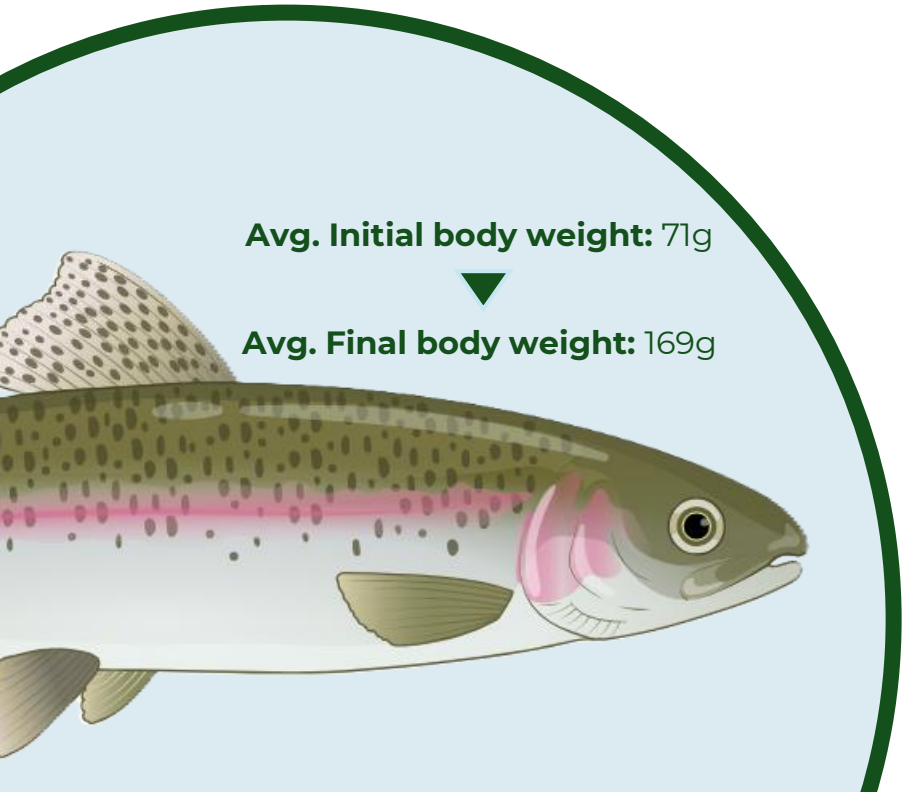
Scenedesmus spp. (SC)

Experimental diets

CTRL	PT2.5	PT5	Mix
0% Microalgae	2.5% PT	5% PT	2.5% PT 2.5% SC

Growth trial

Feeding: 2 times / day; *ad libitum*
Duration: 7 weeks



Growth performance and feed utilization

No significant differences were observed on **growth performance, feed utilization** and **survivability**

Health status indicators

No significant differences were observed on **oxidative status, innate immunity parameters** and **circulating metabolites**

Take home message

All experimental diets fully supported the growth performance and health status of rainbow trout juveniles

The CC25 and RW15 diets allowed for improved feed efficiency and RW15 improved growth performance while allowing for 100% fishmeal decoupling



Regulatory limitations under current EU legislaltion

Current economical competitiveness

CONCLUSION

A Resilient, Sustainable Future for Aquaculture

Fundação para a Ciência e a Tecnologia
REPÚBLICA PORTUGUESA
SAFE
European Commission
Funded by the European Union

Is Fishmeal still essential for rainbow trout production ?

A) Absolutely, fishmeal should be the main ingredient
B) Partially, some fishmeal still needs to be included in feeds
C) No, but we shouldn’t expect an increase in fish performance
D) No, more sustainable alternatives that improve feed utilisation are increasingly available!

