



FUTURE
EU AQUA



Work Package 2

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Overview of WP2

Sustainable and resilient feed and feeding strategies

WP2 role is to coordinate the research activity and efforts to develop innovative, species specific nutritionally adequate, tailor-made, low ecological footprint organic and conventional diets and validate them in different fish production systems.

WP2 demonstrated sustainable and resilient nutritional solutions for highest possible fish performances that are safe and commercially available for the European aquaculture.

Overview of WP2

WP2 Objectives

1. Verify the breeding potential for nutrition and health physiology traits in fish that will enable sustainability and resilience in future aquaculture (**Task 2.1**).
2. Fine-tune feed formulations for smart optimized and better performing conventional and organic aquaculture, safeguarding nutritional quality and safety of the final product (**Task 2.2**).
3. Verify the potential of innovative low ecological footprint aquafeeds, in terms of fish performance and health in large scale farm level (TRL6-8) for well-established farmed species (**Task 2.3**).
4. Assess the potential of fish microbiome to enhance health and productivity of farmed species (**Task 2.2, 2.3**).

WP2 Tasks

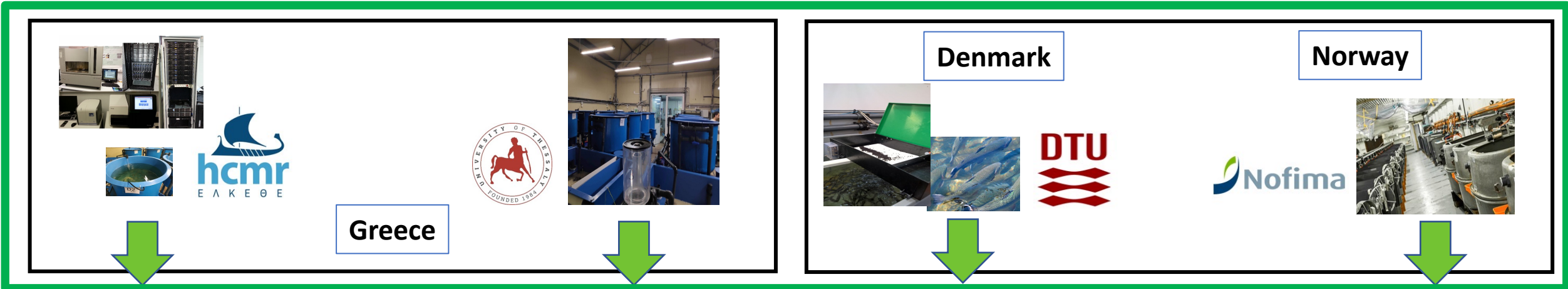
1. Innovative raw material selection
2. Chemical analysis of raw materials
3. Experimental diet formulation and diet production for organic and conventional aquaculture
4. Analysis of the diets' chemical composition
5. Feeding trials, in laboratory-small scale (tanks) and in large scale tanks (cages)
6. Fish performance, physiology and health

WP2 Diets

- 1) Salmon & sea bream feeding trials: Fish meal (organic and conventional), tunicate meal, black soldier fry meal, *Phaeodactylum tricornutum* and *Schizochytrium limacinum* biomasses and fish oil (organic and conventional)
- 2) Trout feeding trial: Fish meal and fermented soy and rapeseed meals
- 3) Sea bass and sea bream feeding trials: Conventional fish meal, fish meal made from trimmings, krill meal, bacterial protein, yeast protein, algal meal (*Schizochytrium limacinum*), squid meal, pea protein (organic), rapeseed oil and fish oil (organic and conventional), corn gluten, wheat gluten, soy bean meal, fermented soya.



WP2 Feeding fish trials with FutureEU Aqua novel aquafeeds

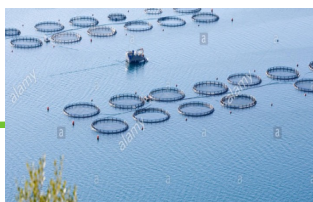
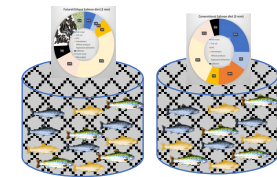
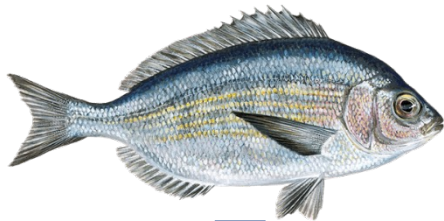
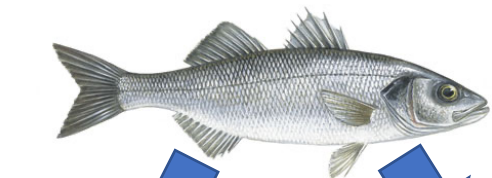


European sea bass

Sea bream

Rainbow trout

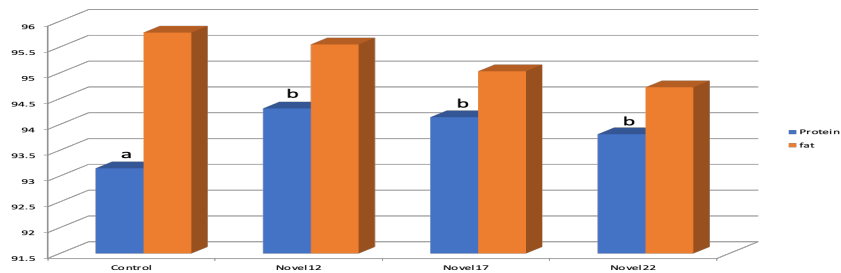
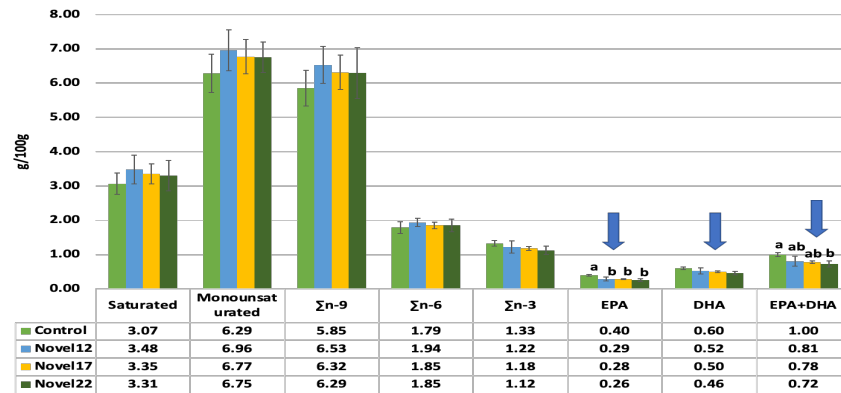
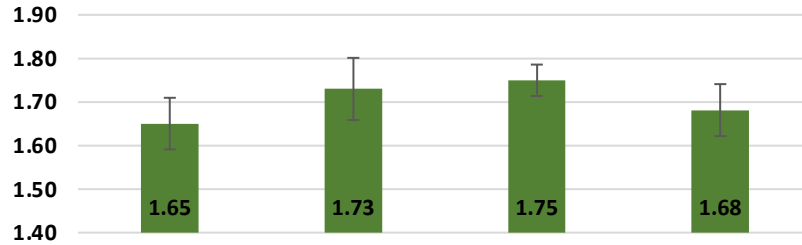
Atlantic salmon



WP2 Results

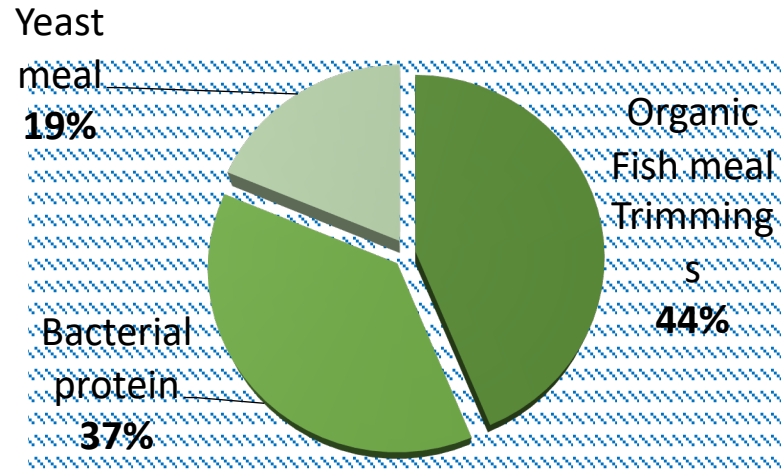


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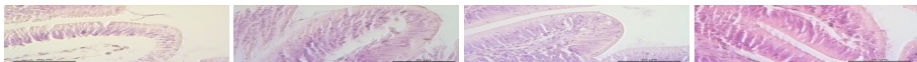


- ✓ Best growth and FCR for Conventional and Trimmings mixture with moderate inclusion of Novel ingredients
- ✓ Trend observed for higher final weight of moderate inclusion of Novel ingredients for organic aquaculture
- ✓ Improved FCR at moderate inclusion of Novel ingredients for organic aquaculture

Low FiFo for organic diets



Higher growth performance for **LFiFo25** diet compared to control diet



Posterior gut appears to have normal structure in all dietary groups with normally distribution of goblet cells. There are no signs of inflammation.

WP2 Results



The total replacement of fishmeal with **algae meal**, (*Phaeodactylum tricornutum* and *Schizochytrium limacinum*), **insect meal** (black soldier fry) and **tunicate meal** (*Chiona intestinalis*) and no fish oil did not affect sea bream growth performance.

However, sea breams showed better growth performance when they fed **organic fish meal**, **krill**, and **algae** (*Schizochytrium limacinum*, HA) and *Phaeodactylum tricornutum*, PA) and slow growth rates when they fed on **tunicate meal**.

Task 2.3 Large scale fish trials with novel conventional and organic aquafeeds

Subtask 2.3.1. Focus Mediterranean species

- The best performing innovative formulations based on Task 2.2
- Evaluation in large scale field studies (operational environment)
- Conventional and organic gilthead seabream (KEFALONIA)
- Organic European seabass (GALAXIDI)
- Conventional European seabass (AVRAMAR-NIREUS)
- The trial feeds were produced by IRIDA and AVRAMAR- NIREUS



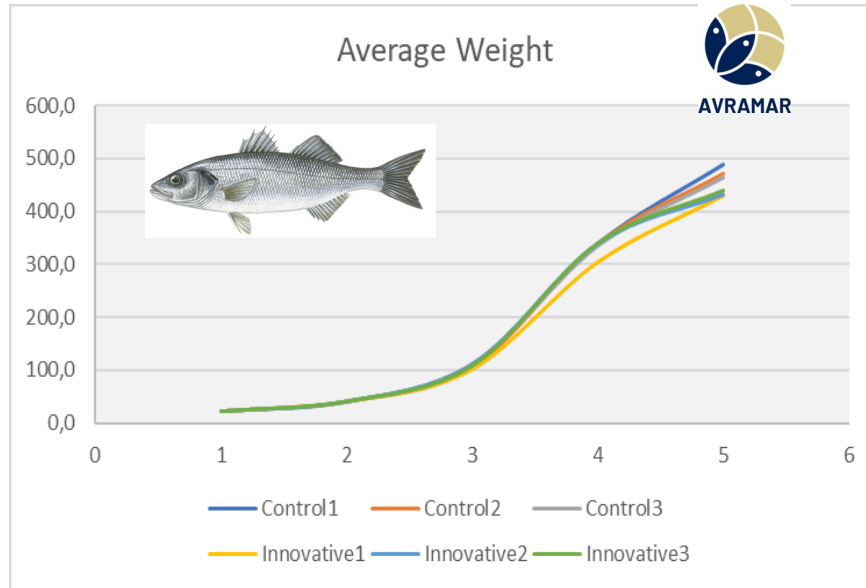
● **Select novel organic ingredients materials**

- *Pea protein*
- *Yeast*
- *Fermented soya*

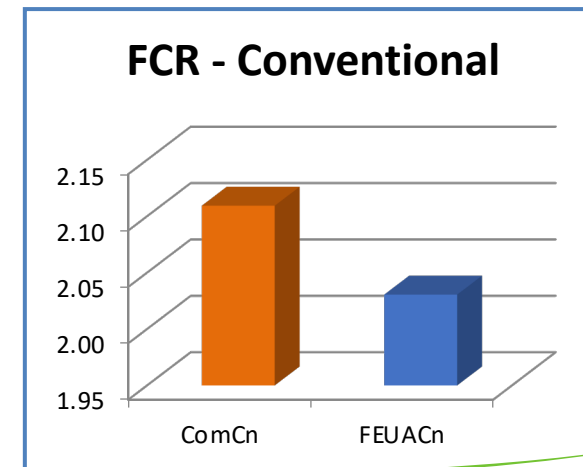
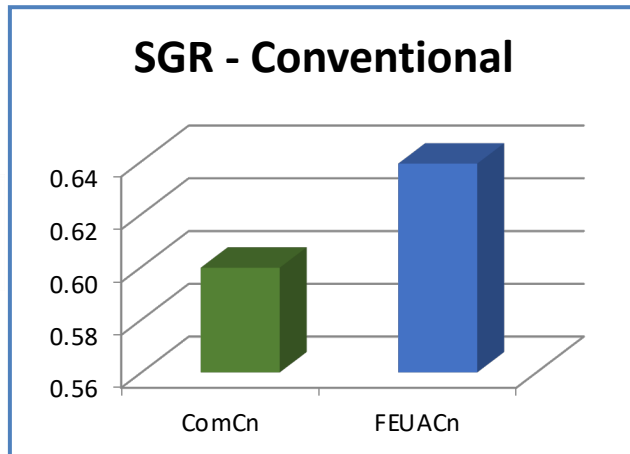


Mediterranean species (sea bream and sea bass)

WP2 Results



- ✓ Trent observed for higher final weight for feeds with inclusion of Novel ingredients compared to Control diet
- ✓ Same tend for improved FCR
- ✓ No significant differences in whole body and fillet composition among all groups



Ingredients to be tested for **conventional trout farming:**

fermented rapeseed meal and
fermented soybean meal

Why ? Fermentation may deactivate antinutritional factors and reduce undesirable substances.

Up to 15 % inclusion of fermented soybean meal might replace conventional soybean meal without any negatively effects on growth performance in rainbow trout.

The tested rapeseed meal and fermented rapeseed meal in their present form needs refinement/optimization to ensure better growth performance.

WP2 Results



Ingredients to be tested for **organic trout farming**

Rules for antinutrient removal have to follow organic rules. Organic regulation does not allow synthetic amino acids to balance diets – hence; few high protein alternatives is fish meal.

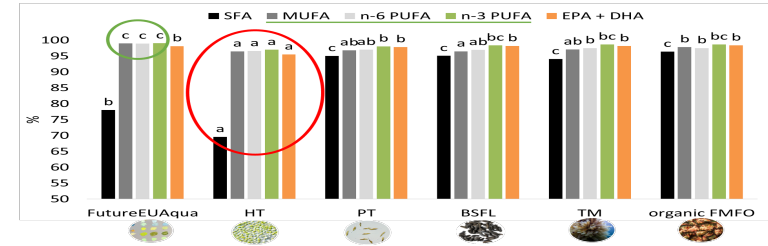
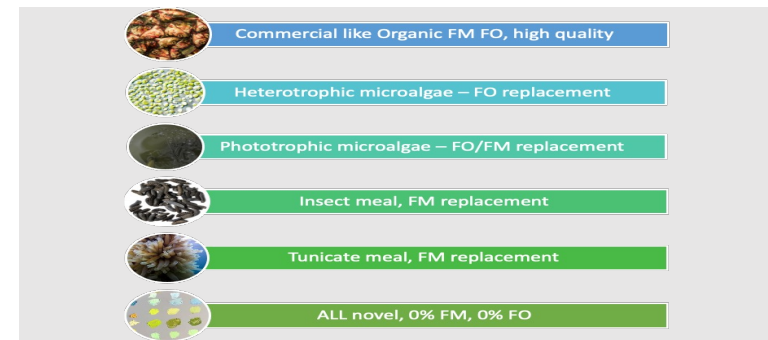
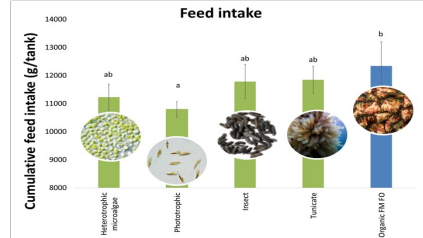
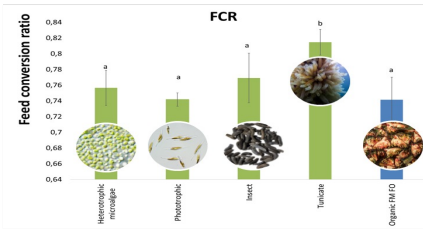
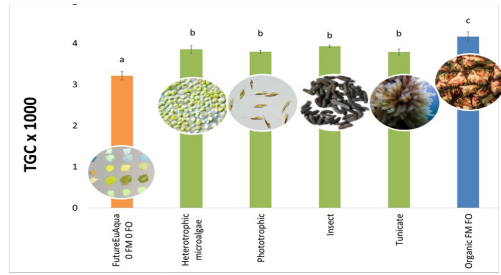
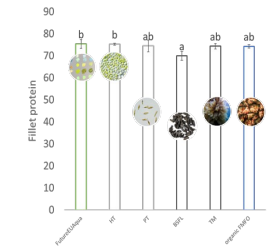
Fish meal protein concentrate processed from trimmings

Why ? Traditional fish meal or fish trimmings has an environmental draw back with a high phosphorus (P) content. New technology has developed this type with low P content and high protein content (**>80 % protein**) -thus allowing high protein and high energy – not common in organic diets.

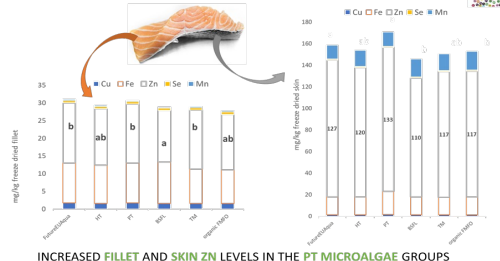
Results with **organic trout** showed that fishmeal trimming protein concentrate **could replace conventional dietary fishmeal trimming inclusion by 65% without any negative effect on performance.**

WP2 Results

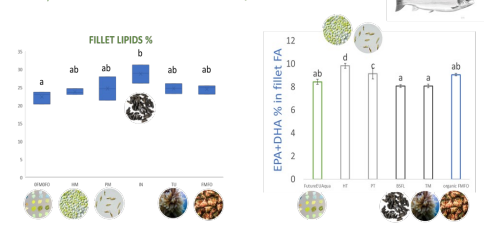
7. PRODUCT QUALITY, FILLET PROTEIN



7. HEALTH (SKIN AND FILLET MINERALISATION) AND QUALITY



7. LIPID/ENERGY METABOLISM AND PRODUCT QUALITY

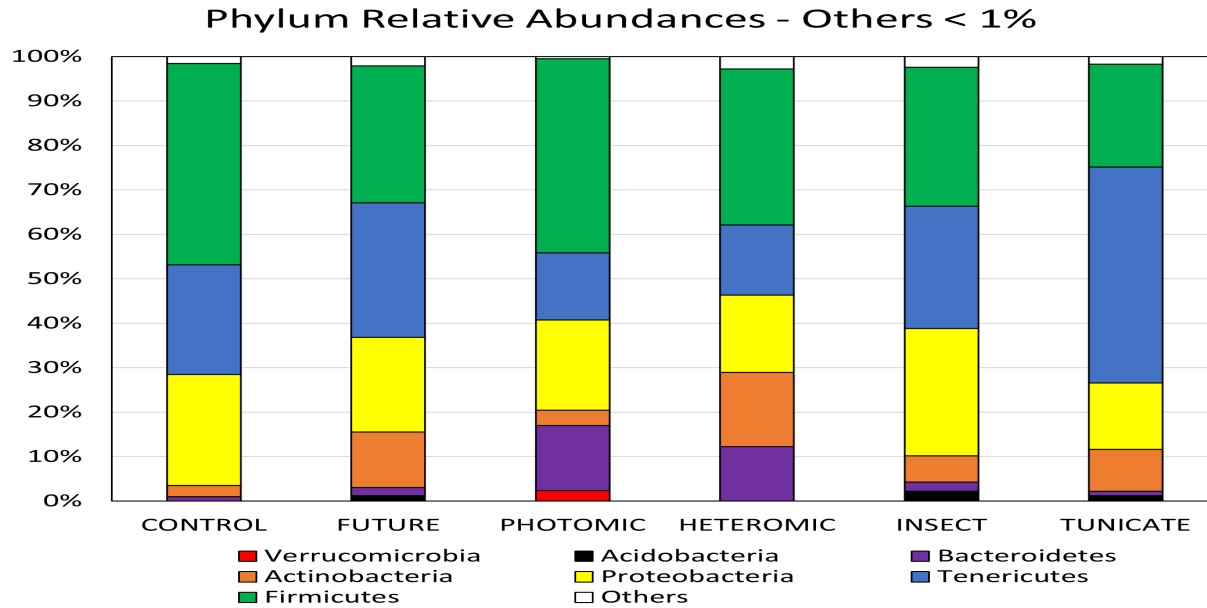


- High performance in particular in terms of **FCR** and **synergistic effects** of innovative ingredients as FO and FM replacers in salmon diets.

- Superior ADC and performance when they fed the organic fish meal and fish oil diet.

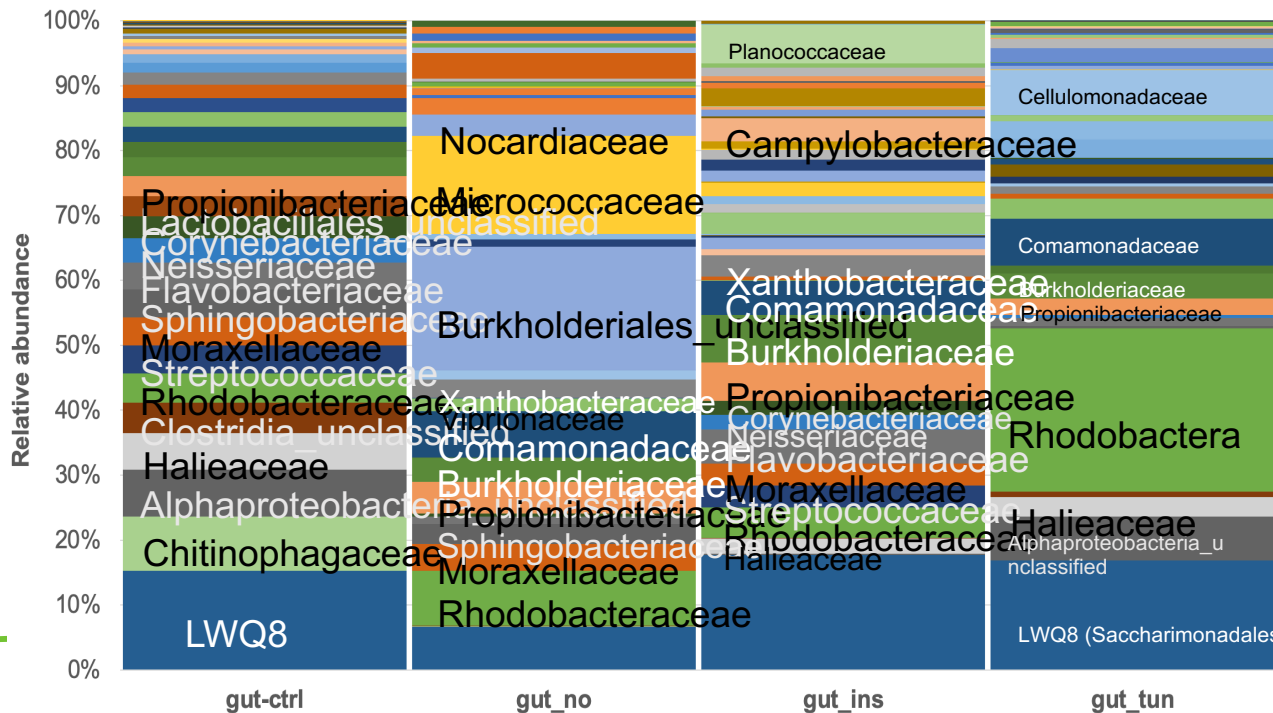


Diet is a major factor driving the composition and metabolism of the gut microbiota while gut microbiota is actively involved in nutrient assimilation and immunity of the host organism.



FutureEU Aqua Salmon (My)Bioma

Gut bacterial taxa with beneficial metabolic services to their host



FutureEU Aqua Seabream (My)Bioma

Impact & Innovation value of the WP2

The main innovative action that FutureEUAqua WP2 achieved is:

Innovative and sustainable feeds and farming management solutions

Impact - Improve tailor made feeding formulas:

Optimizing and fine-tuning tailor-made feeding formulas and technologies for conventional and organic aquaculture that improved the nutritional quality and safety of the final product (sea bass, sea bream, rainbow trout, Atlantic salmon) in relation to human nutritional expectations and respect for fish welfare.

Optimizing blending strategy for precision feeding and increased feeding efficiency.

Outcomes

Sustainable diets tailored to growth and health performances. Microbiome community and barrier tissue welfare indication analysis to aid tracing fish and farming conditions.

Indicators:

Different number of fine-tuned species-specific feed formulations for the Gilthead sea bream, European sea bass, rainbow trout, Atlantic salmon for smart optimized and better performing conventional and organic aquaculture safeguarding nutritional quality and safety of the final product.

Impact & Innovation value of the WP2

CURRENT STATUS: **large scale** production of **algae** and **insect** meal and implementation in **commercial salmon farming**

Algae-based feed effort focuses on providing sustainable, alternative ingredient

By Aerin Einstein-Curtis

02-Nov-2018 - Last updated on 31-Jan-2019 at 11:43 GMT



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Consumer interest in aquaculture production and nutrition supports the role of alternative, algae-based omega-3 feed ingredients.

Lerøy flags up use of microalgae sourced DHA in its salmon diets

By Jane Byrne

24-Apr-2017 - Last updated on 27-Apr-2017 at 12:05 GMT



© Lerøy

RELATED TAGS: Fatty acids, Omega-3 fatty acid, Eicosapentaenoic acid

Salmon producer, Lerøy, says it has reduced its use of marine sourced omega-3 fatty acids by switching to a feed incorporating a DHA laden microalgae product.

InnovaFeed opens biggest insect protein plant globally, secures €140m in funds, and partners with ADM to build US site

By Jane Byrne

19-Nov-2020 - Last updated on 19-Nov-2020 at 15:04 GMT




InnovaFeed's new BSF protein production plant, located in Nesle in northern France, is now operational. © InnovaFeed



Links with other WPs

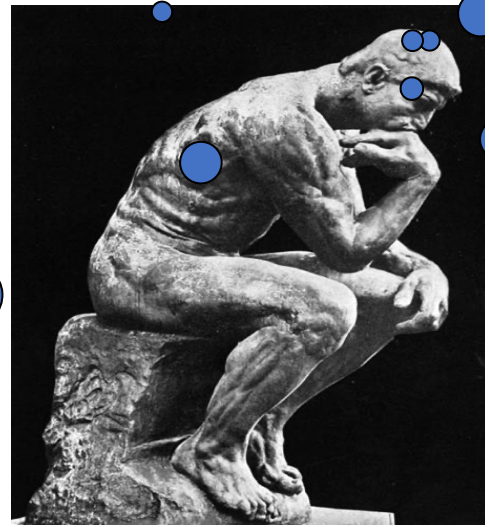
WP5



WP1



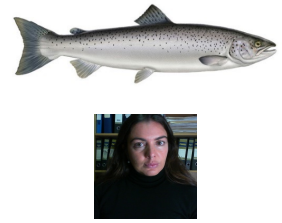
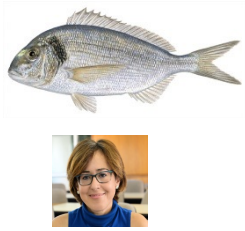
WP2



WP6



WP4





WP2 team
Thank you!!!



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Thank you for your attention and contribution!

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