

IATS Nutrigenomics Group

web tools of practical use in aquaculture

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ARRAINA Biomarkers database

Nutrigenomics and Fish Growth Endocrinology Group
Institute of aquaculture Torre de la Sal, CSIC

IN SILICO TOOLS

Fish species by partners

Carp (HAKI)
Sea bass (UJI/ULPGC)
Atlantic Salmon (NIFES, UoS)
Sea bream (CSIC/CCMAR)

ARRAINA Biomarkers
Identify easy and highly informative nutritionally-regulated biomarkers for the five fish species of the project

Aquafat AGL 2009
What do we eat? Interactive tool for predictive modelling fish fatty acid composition

Sea bream transcriptomic database

***Sparus aurata* transcriptomic database**
Data derived from GenBank complete mRNA sequences, a collection of assembled annotated ESTs, and 85,350 new sequences

***Dicentrarchus labrax* transcriptomic database**
Data derived from public repositories of mRNA, collections of ESTs and new high-quality reads from five cDNA 454 normalized libraries

AQUAFAT Fillet fatty acid prediction tool

Sea bass transcriptomic database

The screenshot shows the homepage of the USSEC 2017 website. At the top, there's a banner for the "TRAINING COURSE ON FISH NUTRITION RESEARCH BENICASSIM 2017" featuring a cartoon fish character. Below the banner, there's a sidebar with links to "Abstracts book", "ARRAINA Technical Booklets" (with sub-links for "Feed ingredients", "Nutrient requirements", "Biomarkers in fish nutrition", and "ARRAINA Key Achievements"), and a large image of the course abstract book. The main content area has a "Program" section with a detailed description of the course, mentioning sponsors like CSIC, IATS, and USSEC, and partners like IEU, INIA, and others. It also lists topics such as larval nutritional programming, nutrient x genotype interactions, resistance to bacterial and parasite infections, food safety, and long-term consequences of low fish meal/fish oil diets. A modal window is overlaid on the page, containing sections for "Project links" and "Web tools". The "Project links" section contains a link to the "Training Course on Fish Nutrition Research: Recent Advances and Perspectives". The "Web tools" section contains links to a "Biomarkers Database", "Fatty Acid Prediction", "Sea bream Transcriptome", and "Sea bass Transcriptome". To the right of the modal, there are two images: one of a hotel building and another of an aquaculture facility.

Project links -

Web tools -

Training Course on Fish Nutrition Research: Recent Advances and Perspectives

Biomarkers Database

Fatty Acid Prediction

Sea bream Transcriptome

Sea bass Transcriptome

Program

Welcome to the Training Course on Fish Nutrition Research: Recent Advances and Perspectives. This course is organized by the Nutrigenomics and Fish Health Research Group of Institute of Aquaculture and Fisheries Research. The course is sponsored by the European Union, the Spanish Ministry of Science and Innovation, and the Regional Government of Valencia. The course is directed to R+D personnel of the aquaculture sector working in fish nutrition. From June 13 to 15, conferences will be held at Hotel Voramar in Benicàssim (Nutrigenomics and Fish Health Research Group, Dr. Kaushik and G. Corraze, Dr. Afonso and Sparos Lda).

Topics will cover a wide range of nutrition-mediated issues: larval nutritional programming, nutrient x genotype interactions, resistance to bacterial and parasite infections, food safety, and long-term consequences of low fish meal/fish oil diets in fish species of interest in aquaculture (rainbow trout, European sea bass, gilthead sea bream).

Main results and conclusions are from the ARRAINA EU Project. Current research on ongoing H2020 Projects (ParaFishControl, AQUAEXCEL²⁰²⁰) is also presented.

The Course will be completed with a visit to IATS-CSIC facilities on June 16.

We hope you enjoy your stay and the lectures, in order to have a productive and enjoyable Course.

ARRAINA BIOMARKER DATABASE

www.nutrigroup-iats.org/arraina-biomarkers

The screenshot shows the ARRAINA Biomarker Database interface. At the top, there is a navigation bar with the ARRAINA Biomarkers logo, 'About the project', 'Help', and 'Login' buttons. Below the navigation bar is a 'Filters panel: Choose a nutrient and/or a biological process' section with dropdown menus for 'Nutrient' and 'Biological process'. To the right of this is a 'General search' input field and an 'Export to Excel' button. The main content area displays a table titled 'Showing 801 rows' with columns: Nutrient, Biological process, Metabolic process / Subcompartiment, Marker, Symbol, GenBank number, Description, Method, Tissue, Invasive, Species, Stage, Organisation level, Metabolism, Response (early + 6 weeks / late + 6 weeks), Dietary level (µg/kg), and Reference. The table lists various biomarkers related to glucose metabolism across different fish species like trout, sea bream, and salmon.

On-line tool for searching informative biomarkers of nutrient requirements or specific biological processes

- **Interactive & collaborative:** Inputs from INRA, NIFES, UoS, CSIC, ULPGC, HAKI, USI and CCMAR
- More than **800 entries, >20 fish species**



ARRAINA BIOMARKER DATABASE

www.nutrigroup-iats.org/arraina-biomarkers

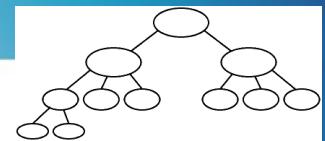
The screenshot shows the ARRAINA Biomarker Database interface. At the top, there is a navigation bar with the ARRAINA logo, 'Biomarkers', 'About the project', 'Help', and 'Login' buttons. Below the navigation bar is a 'Filters panel: Choose a nutrient and/or a biological process' section with two dropdown menus: 'Nutrient' and 'Biological process', each with a search input field and a clear button. To the right of this is a 'General search' input field and a 'Search' button. The main content area displays a table of search results with the following columns: Nutrient, Biological process, Metabolic process (de)contamination, Marker, Symbol, Genbank number, Description, Method, Tissue, Invasive, Species, Stage, Organisation level, Metabolism, Response (early + 6 weeks / late + 6 weeks), Dietary level (µg/kg), Reference, and Comments. The table contains 10 rows of data, each corresponding to a different biomarker entry.

Nutrient	Biological process	Metabolic process (de)contamination	Marker	Symbol	Genbank number	Description	Method	Tissue	Invasive	Species	Stage	Organisation level	Metabolism	Response (early + 6 weeks / late + 6 weeks)	Dietary level (µg/kg)	Reference	Comments
Glucose	None	None	Glucokinase	GK	AF05331	gPCR	Liver	Yes	Trout					Panserat et al., 2000; Bissner et al., 2013			
Glucose	None	Glycolysis	Glucokinase	GK	AF05330	Enzymatic assay	Liver	Yes	Sea bream					< 10 µg/kg	Eres et al., 2006, 2010; Moreira et al., 2008		
Glucose	None	Glycolysis	Glucokinase	GK	AHC23585	gPCR, Enzymatic assay	Liver	Yes	Sea bream					> 10 µg/kg	Gómez-Requeni et al., 2003		
Glucose	None	Glycogenesis	Glucose-6-phosphatase	GPIase	AF427986	gPCR, Enzymatic assay	Liver	Yes	Sea bream					>20 µg/kg	Panserat et al., 2002; Gómez-Requeni et al., 2003		
Glucose	None	Glycogenesis	Fuctose 1,6-bisphosphate	FBPase	AF427987	gPCR	Liver	Yes	Sea bream					10-20 µg/kg	Panserat et al., 2002; Gómez-Requeni et al., 2003		
Glucose	None	Glycogenesis	Phosphoglycolate carboxylesterase	PEPCk	AF427988	gPCR	Liver	Yes	Sea bream					20 µg/kg	Panserat et al., 2002; Gómez-Requeni et al., 2003		
Glucose	None	Fructose phosphate pathway	Glucose-6-phosphate dehydrogenase	GPD	EF551311	gPCR, Enzymatic assay	Liver	Yes	Trout						Transki et al., 1991; Chung et al., 2006		
Glucose	None	Fructose phosphate pathway	Glucose-6-phosphate dehydrogenase	GPD	AF427989	Enzymatic assay	Liver	Yes	Sea bream						Eres et al., 2006, 2010; Moreira et al., 2008; Pérez & Oliva-Telles, 2005		
Glucose	None	Fructose phosphate pathway	Glucose-6-phosphate dehydrogenase	GPD	AF427990	gPCR, Enzymatic assay	Liver	Yes	Sea bream						Gómez-Requeni et al., 2003		

On-line tool for searching informative biomarkers of nutrient requirements or specific biological processes

- Filter by **nutrient** and/or **biological process**
- Also includes information for the assessment of **fish safety**
- General search box
- Public users can search and download filtered data

Biological process: “tree” categories



Development	<ul style="list-style-type: none">• Bone mineralization• External appearance	<ul style="list-style-type: none">• Skeletal development• Skeletal integrity	<ul style="list-style-type: none">• Skeletal morphology
Growth	<ul style="list-style-type: none">• Digestion• Energy wastage• Feeding behaviour• Growth dynamics	<ul style="list-style-type: none">• Muscle growth• Muscle structure• Nutrient sensor	<ul style="list-style-type: none">• Performance• Protein turnover• Somatotropic axis
Health & Welfare	<ul style="list-style-type: none">• Antioxidant defence• Apoptosis• Cell differentiation• Cell signalling pathway• Eicosanoid production	<ul style="list-style-type: none">• External appearance• Haematology• Inflammatory response• Innate immune response• Internal appearance	<ul style="list-style-type: none">• Iron metabolism• Specific immune response• Tissue homeostasis• Tissue remodelling• Viral response
Quality at harvest	<ul style="list-style-type: none">• Fillet FA composition		
Reproductive performance	<ul style="list-style-type: none">• Fecundity• Fertility	<ul style="list-style-type: none">• Gonad development• Sexual maturation	<ul style="list-style-type: none">• Sperm quality• Vitellogenesis
Safety	<ul style="list-style-type: none">• Biocontaminants		
Stress response	<ul style="list-style-type: none">• Antioxidant defence• Apoptosis• Cell & tissue repair	<ul style="list-style-type: none">• Endocrine status• Energy supply• Hypoxia	<ul style="list-style-type: none">• Metabolite stress• Nuclear transcription factor• Oxidoreductase activity

ARRAINA Biomarkers database



Filters panel: Choose a nutrient and/or a biological process

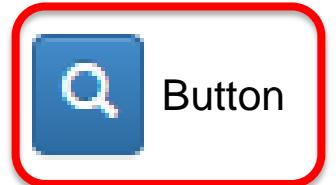
Nutrient

🔍✖

Biological process

🔍✖

General search



Showing 805 rows.

1 2 3 > Last ›

Nutrient	Level in diet (units)	Biological process	Metabolic process / biocontaminant	Marker	Symbol	GenBank number	Description	Method	Tissue	Invasive	Species	S
Glucose	None	None	Glucokinase	GK	AF053331		qPCR	Liver	Yes	Trout		

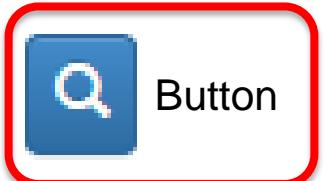
ARRAINA Biomarkers database



Filters panel: Choose a nutrient and/or a biological process

Nutrient	<input type="text"/>		
Biological process	<input type="text"/>		

General search



Button

Choose a biological process

- All
- None
- Development
- Growth
- Health & Welfare
- Quality at harvest
- Reproductive performance
- Safety
- Stress response



Showing 805 rows.

[1](#) [2](#) [3](#) [>](#) [Last](#)

Nutrient	Level in diet (units)	Biological process	Metabolic process / biocontaminant	Marker	Symbol	GenBank number	Description	Method	T
Glucose		None	None	Glucokinase	GK	AF053331		qPCR	L
Glucose		None	Glycolysis	Glucokinase	GK	AF053330		Enzymatic assay	L
Glucose		None	Glycolysis	Glucokinase	GK	AAC33585		qPCR,Enzymatic assay	L

ARRAINA Biomarkers database



Filters panel: Choose a nutrient and/or a biological process

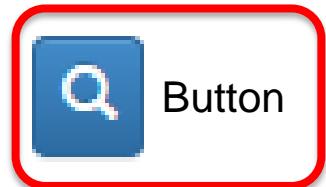
Nutrient

Biological process

Metabolic process / biocontaminant

General search

Showing 72 rows. 1 2 3 > Last



Button

Nutrient	Level in diet (units)	Biological process	Metabolic process / biocontaminant	Marker	Symbol	GenBank number	Description	Method	Tissue	Invasive	Species	Stage
Amino acid	Growth	Digestion	PepT1	FJ237043			qPCR	Intestine	Yes	Sea bass		
None	Growth	Performance	Specific growth rate	SGR			Weight	Population	No	Trout		
None	Growth	Performance	Specific growth rate	SGR			Weight	Population	No	Carp		
None	Growth	Performance	Specific growth rate	SGR			Weight	Population	No	Sea bass		
None	Growth	Performance	Specific growth rate	SGR			Weight	Population	No	Sea bream		
W'	None	Growth	Performance	Specific growth rate	SGR		Weight	Population	No	Salmon		



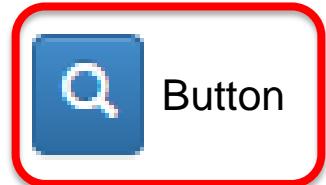
ARRAINA Biomarkers database



Filters panel: Choose a nutrient and/or a biological process

Nutrient	<input type="text"/>	<input type="button" value="🔍"/>
	<input type="button" value="X"/>	
Biological process	<input type="text"/>	<input type="button" value="🔍"/>
Growth	<input type="text"/>	<input type="button" value="🔍"/>
	<input type="button" value="X"/>	
Metabolic process / biocontaminant	<input type="text"/>	<input type="button" value="🔍"/>
	<input type="button" value="X"/>	

General search



Choose a metabolic process / biocontaminant

- All
- None
- Digestion
- Energy wastage
- Feeding behaviour
- Growth dynamics
- Muscle growth
- Muscle structure
- Nutrient sensor
- Performance
- Protein turnover
- Somatotropic axis

 Species Refine search

Showing 72 rows.

[1](#) [2](#) [3](#) [>](#) [Last >](#)

Nutrient	Level in diet (units)	Biological process	Metabolic process / biocontaminant	Marker	Symbol	GenBank number	Description	Method	Tissue	Invasive	Species	Stage

ARRAINA Biomarkers database

Filters panel: Choose a nutrient and/or a biological process

Nutrient

Biological process

Metabolic process / biocontaminant

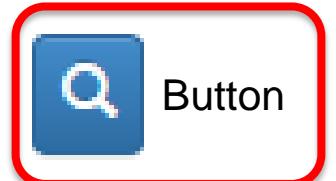
Growth Muscle growth

All Method Tissue Invasive Species Stage Organisation_level Response

Showing 20 rows.

1 2 >

Nutrient	Level in diet (units)	Biological process	Metabolic process / biocontaminant	Description	Method	Tissue	Invasive	Species	Stage	
None		Growth	Muscle growth	Myogenic differentiation 1	MyoD1	X75798	qPCR	Muscle	Yes	Trout
None		Growth	Muscle growth	Myogenic differentiation 1	MyoD1		qPCR	Muscle	Yes	Sea bass
None		Growth	Muscle growth	Myogenic differentiation 1	MyoD1	AF478568	qPCR	Muscle	Yes	Sea bream
None		Growth	Muscle growth	Myogenic differentiation 1a	MyoD1a	AJ557148	qPCR	Muscle	Yes	Salmon
None		Growth	Muscle growth	Myogenic differentiation 1b	MyoD1b	AJ557150	qPCR	Muscle	Yes	Salmon
None		Growth	Muscle growth	Myogenic	MyoD1c	DQ317527	qPCR	Muscle	Yes	Salmon



Button

Refine search

ARRAINA Biomarkers database

Filters panel: Choose a nutrient and/or a biological process

Nutrient

🔍
✖

Biological process

Growth	🔍	Muscle growth	🔍
✖	✖		

Sea bream

Species

Refine search

✖

General search

🔍

Button

Showing 5 rows.

Export to Excel

Nutrient	Level in diet (units)	Biological process	Metabolic process / biocontaminant	Marker	Symbol	GenBank number	Description	Method	Tissue	Invasive	Species	Stage	Reference
None		Growth	Muscle growth	Myogenic differentiation 1	MyoD1	AF478568		qPCR	Muscle	Yes	Sea bream		Tan & Du, Dev., 2002
None		Growth	Muscle growth	Myogenic differentiation 2	MyoD2	AF478569		qPCR	Muscle	Yes	Sea bream		Tan & Du, 2002
None		Growth	Muscle growth	Myogenic factor 5	Myf5	JN034420		qPCR	Muscle	Yes	Sea bream		García de la Serrana et al., 2014, Comp Biochem Physiol A
None		Growth	Muscle growth	Myogenic factor 6	Myf6/NRF4/herculin	JN034421		qPCR	Muscle	Yes	Sea bream		García de la Serrana et al., 2014, Comp Biochem Physiol A
None		Growth	Muscle growth	Myogenin	Myog	EF462191		qPCR	Muscle	Yes	Sea bream		Codina et al., 2008

Refine search

Export to Excel



ARRAINA Biomarkers database

Filters panel: Choose a nutrient and/or a biological process

Nutrient

🔍✖

Biological process

🔍✖

- Choose a nutrient
- All
 - None
 - α-Tocopherol
 - Amino acid
 - Ascorbic acid
 - Biotin
 - Boron
 - Calcium
 - Chromium
 - Cobalamin
 - Cobalt
 - Copper
 - DHA
 - Fluoride
 - Folate
 - Glucane (Bio-Mos)
 - Glucose
 - Iodine
 - Iron
 - Lipids & FA
 - Magnesium
 - Manganese
 - Methionine
 - Molybdenum
 - Na-butyrate
 - Niacin
 - Pantothenic acid
 - Phosphorous
 - Potassium
 - Riboflavin
 - Selenium
 - Taurine
 - Thiamine
 - Vitamin A
 - Vitamin B6
 - Vitamin D
 - Vitamin K
 - Zinc
- 

General search



Button

Refine search

Export to Excel

ARRAINA Biomarkers database

Filters panel: Choose a nutrient and/or a biological process



Nutrient

Vitamin A

Biological process

Species Refine search

General search



Showing 9 rows.

Nutrient	Level in diet (units)	Biological process	Metabolic process / biocontaminant	Marker	Symbol	GenBank number	Description	Method	Tissue	Invasive	Species
Vitamin A		None	None	CYP26				qPCR	Liver	Yes	Atlantic salmon
Vitamin A		None	None	Bone deformity				X-ray	Vertebrae	No	Flounder,Rainbow trout
Vitamin A		None	None	Fecundity				Weight	Ovary	No	Atlantic salmon

ARRAINA Biomarkers database



Nutrient

Search	Clear
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Biological process

Health	Search	Clear
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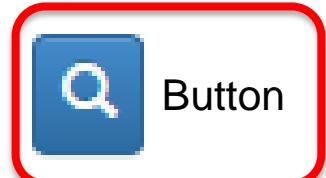
All	Refine search	Clear
Showing 39 rows	Export to Excel	
1 2 3 > Last		

Metabolic process

inflammatory response	Search	Clear
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Showing 39 rows

Nutrient	Biological process	Metabolic process	Marker	Symbol	GenBank number	Description	Method	Tissue	Invasive	Species	Stage
	Health	inflammatory response	Cluster of differentiation 4	CD4	AM849811		qPCR	Head kidney,Intestine	Yes	Sea bass	
	Health	inflammatory response	Cluster of differentiation 4	CD4	AM849811		qPCR	Head kidney,Intestine	Yes	Sea bass	
	Health	inflammatory response	Cluster of differentiation 4	CD4	?		qPCR	Heart	Yes	Salmon	
	Health	inflammatory response	Interleukin 12b	IL12 β	BT049114		qPCR	Heart	Yes	Salmon	



Button

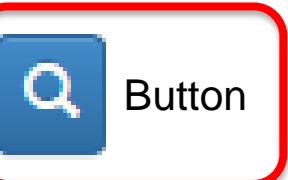
Refine search

Export to Excel

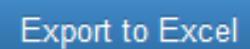
ARRAINA Biomarkers database



Biological process			Metabolic process					
Health			inflammatory response					
Showing 39 rows.								
1	2	3	> Last					
Nutrient	Biological process	Metabolic process	Symbol	GenBank number	Description	Method	Tissue	Invasive Species Stage
	Health	inflammatory response	CD4	AM849811		qPCR	Head kidney,Intestine	Yes Sea bass
	Health	inflammatory response	CD4	AM849811		qPCR	Head kidney,Intestine	Yes Sea bass
	Health	inflammatory response	CD4	?		qPCR	Heart	Yes Salmon
	Health	inflammatory	Interleukin 12b	IL12 β	BT049114		qPCR	Heart
								Yes Salmon



Button



ARRAINA Biomarkers database



Nutrient 🔍 ✖

Biological process 🔍 ✖

Health 🔍 ✖

Metabolic process 🔍 ✖

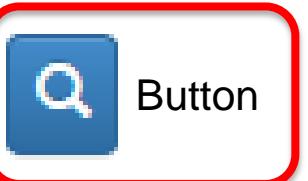
inflammatory response 🔍 ✖

intestine Tissue ▼ Refine search ✖

Showing 9 rows. Export to Excel

Nutrient	Biological process	Metabolic process	Marker	Symbol	GenBank number	Description	Method	Tissue	Invasive	Species	Stage
Health	inflammatory response	Cluster of differentiation 4	CD4	AM849811		qPCR	Head kidney,Intestine	Yes	Sea bass		
Health	inflammatory response	Cluster of differentiation 4	CD4	AM849811		qPCR	Head kidney,Intestine	Yes	Sea bass		
Health	inflammatory response	Interleukin 1 β	IL1 β	AJ311925		qPCR	Head kidney,Intestine	Yes	Sea bass		
Health	inflammatory response	Interleukin 1 β	IL1 β	AJ277166		qPCR	Head kidney,Intestine,Liver,Spleen	Yes	Sea bream		

2 ↖ 1 → 3



Button

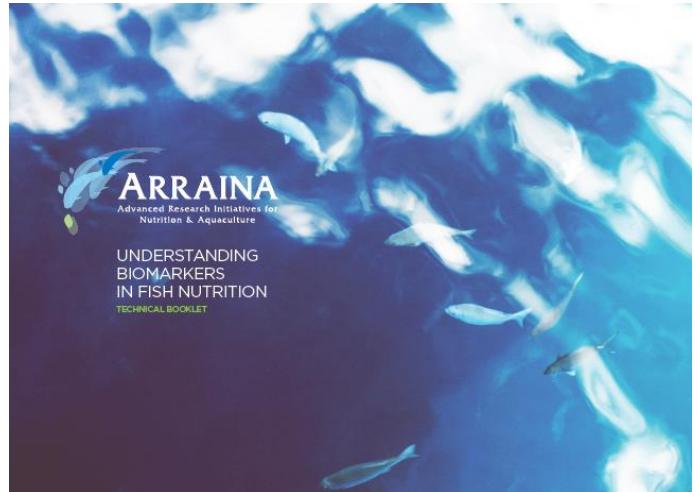
Refine search

Export to Excel

ARRAINA BIOMARKER DATABASE

www.nutrigroup-iats.org/arraina-biomarkers

3rd ARRAINA Technical Booklet



- Biomarkers of Mineral and Vitamin Requirements
- Markers of Methionine Metabolism
- Markers of Lipid metabolism and Growth Performance
- Markers of Intestinal Function and Architecture
- Nutritionally Mediated Effects on the Intestinal Transcriptome
- Potential Presence and Prevalence of Contaminants in Fish Fillets

AQUAFAT: predictive fillet FA composition

www.nutrigroup-iats.org/aquafat

Interactive tool for predictive modelling fish fatty acid composition

The screenshot shows the homepage of the Aquafat website. At the top, there's a banner with the project logo and the text "What do we eat? Interactive tool for predictive modelling fish fatty acid composition". Below the banner are links for Spanish and English versions. The main content area includes sections for "Introduction", "Calculate your profile", and "Methodology". The "Introduction" section discusses the importance of fish oil in the diet and the project's role in ensuring compatibility with healthy fish. The "Calculate your profile" section contains a form to input species (Turbot), diet (Fish oil diet), lipid fillet percentage (12), and units (mg FA/g lipid). The "Methodology" section lists sampling, lipid and fatty acid analyses, dummy regression, and model validation.



Sea bream



Sea bass



turbot



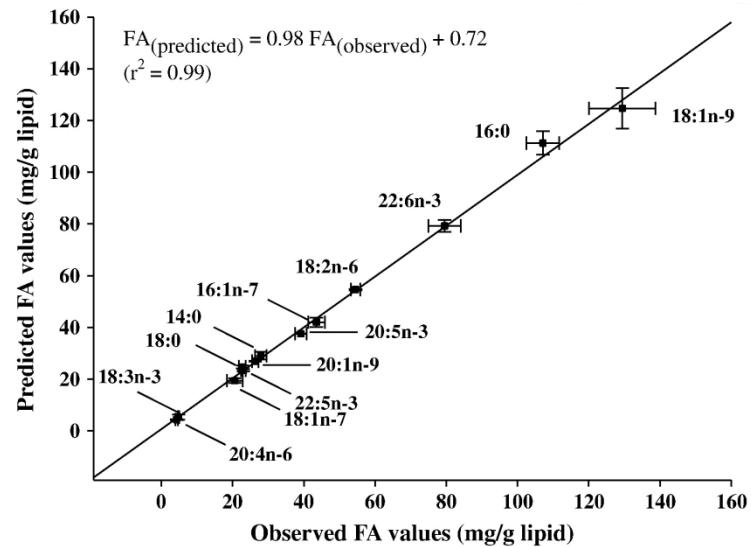
Sole

AQUAFAT: predictive fillet FA composition

www.nutrigroup-iats.org/aquafat

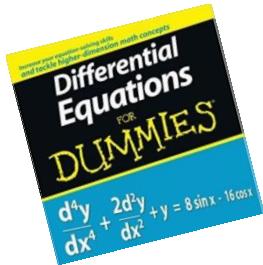
STEP 1: Regression modelling in gilthead sea bream

- Sea bream fed commercial **standard diet**
- **2-years** production cycle
- Sampled every 3-4 months:
 - Total lipid levels
 - FA composition
- Fillet FA composition correlated with:
 - Dietary FA composition
 - Fillet lipid level
- **Validation** with a diet based in PP/FO



AQUAFAT: predictive fillet FA composition

www.nutrigroup-iats.org/aquafat



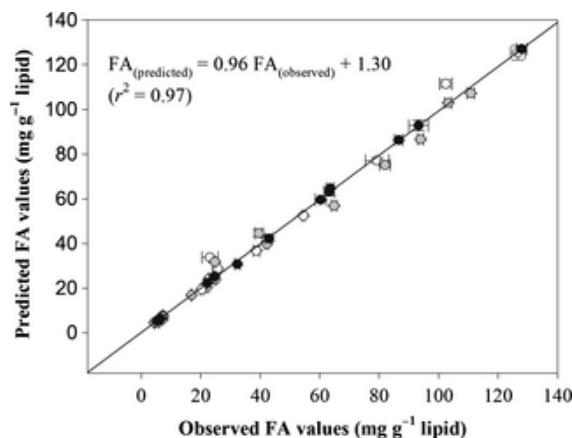
STEP 2: Dummy regression analysis (turbot, sole)

$$y_i = \beta_0 + \beta_1 Z_{1i} + \beta_2 Z_{2i} + \beta_3 Z_{3i} + \beta_4 Z_{4i}$$

- Farmed turbot and sole (North-West Spain) fed commercial diets
- Production cycle (turbot, 24 month; sole, 20 month)
- Sampled at different stages of the production cycle
- **Sea bream** data used as **reference subgroup category**
- **Validation** with data not included in the construction of the model



Sea bream



turbot



Sole

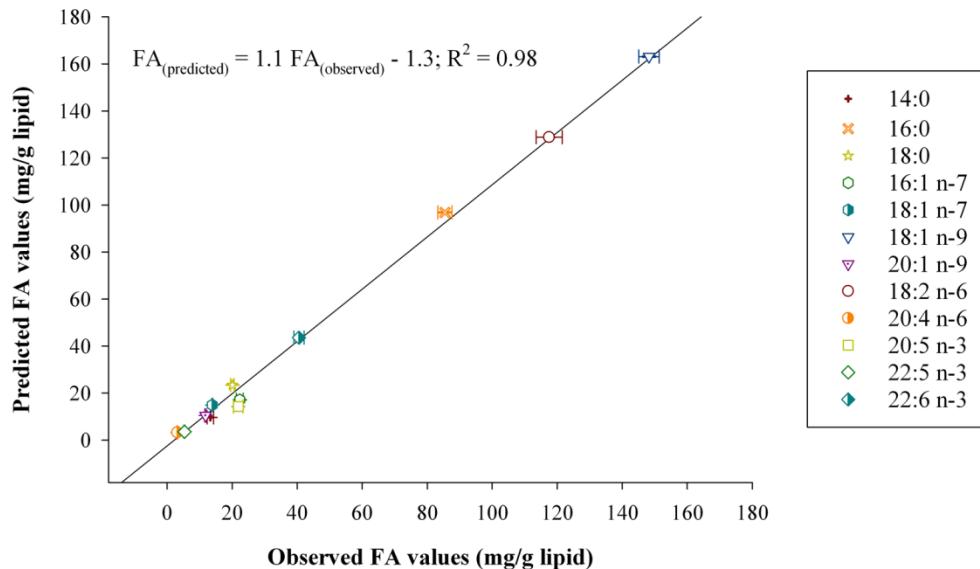


AQUAFAT: predictive fillet FA composition

www.nutrigroup-iats.org/aquafat

STEP 3: Sea bass up-scaling (farm & experimental scale)

- **Sea bream** data used as **reference subgroup category**
- **Dummy variables:** turbot, sole and sea bass (20 months)
- **Validation:** farmed fish harvested at commercial size



AQUAFAT: predictive fillet FA composition



What do we eat? Interactive tool for predictive modelling fish fatty acid composition

Calculate your profile

Specie:	<input type="text" value="Turbot"/> ?
Diet:	<input type="text" value="Fish oil diet"/> ?
Lipid fillet (%):	<input type="text" value="12"/> ?
Units:	<input type="text" value="mg FA/ g lipid"/> ?

OK

- Species: turbot, sole, sea bream, sea bass
- Diet: FO, 33VO, 66VO, VO & **customized**
- Unit as mg FA/ g lipid or mg FA/ 150 g fillet

AQUAFAT: predictive fillet FA composition



Diet: Customized

Fatty acid	mg FA/ g lipid
14:0 (miristic acid)	0.0
16:0 (palmitic acid)	0.0
18:0 (stearic acid)	0.0
16:1 n-7 (palmitoleic acid)	0.0
18:1 n-7	0.0
18:1 n-9 (oleic acid)	0.0
20:1 n-9	0.0
18:2 n-6 (linolenic acid)	0.0
20:4 n-6 (arachidonic acid)	0.0
18:3 n-3 (linoleic acid)	0.0
20:5 n-3 (EPA)	0.0
22:5 n-3 (DPA)	0.0
22:6 n-3 (DHA)	0.0
Saturated ¹	0.0
Monoenes ²	0.0
n-6 PUFA (ω -6) ³	0.0
n-3 HUFA (ω -3) ⁴	0.0



Diet: 66% vegetable oil diet

Fatty acid	mg FA/ g lipid
14:0 (miristic acid)	18.2
16:0 (palmitic acid)	124.6
18:0 (stearic acid)	23.9
16:1 n-7 (palmitoleic acid)	17.6
18:1 n-7	0.7
18:1 n-9 (oleic acid)	165.8
20:1 n-9	6.9
18:2 n-6 (linolenic acid)	117.8
20:4 n-6 (arachidonic acid)	1.2
18:3 n-3 (linoleic acid)	116.8
20:5 n-3 (EPA)	29.5
22:5 n-3 (DPA)	1.6
22:6 n-3 (DHA)	12.7
Saturated ¹	166.6
Monoenes ²	191.0
n-6 PUFA (ω -6) ³	119.0
n-3 HUFA (ω -3) ⁴	43.7

AQUAFAT: predictive fillet FA composition



- Fillet FA reflects FA composition of diet
- Fish tailored to consumer needs
- Robustness of the model facilitates inclusion of new species

Results

Lipid fillet: 12% Print Export

Diet: 66% vegetable oil diet Fillet profile

Fatty acid	mg FA/ g lipid	Fatty acid	mg FA/ 150g fillet
14:0 (myristic acid)	18.2	14:0 (myristic acid)	348.0
16:0 (palmitic acid)	124.6	16:0 (palmitic acid)	2,225.6
18:0 (stearic acid)	23.9	18:0 (stearic acid)	454.0
16:1 n-7 (palmitoleic acid)	17.6	16:1 n-7 (palmitoleic acid)	528.3
18:1 n-7	0.7	18:1 n-7	286.0
18:1 n-9 (oleic acid)	165.8	18:1 n-9 (oleic acid)	3,353.6
20:1 n-9	6.9	20:1 n-9	127.2
18:2 n-6 (linolenic acid)	117.8	18:2 n-6 (linolenic acid)	1,989.5
20:4 n-6 (arachidonic acid)	1.2	20:4 n-6 (arachidonic acid)	28.2
18:3 n-3 (linoleic acid)	116.8	18:3 n-3 (linoleic acid)	1,628.5
20:5 n-3 (EPA)	29.5	20:5 n-3 (EPA)	418.5
22:5 n-3 (DPA)	1.6	22:5 n-3 (DPA)	181.6
22:6 n-3 (DHA)	12.7	22:6 n-3 (DHA)	317.0
Saturated ¹	166.6	Saturated	3,021.0
Monoenes ²	191.0	Monoenes	4,356.8
n-6 PUFA (ω -6) ³	119.0	n-6 PUFA (ω -6)	1,996.8
n-3 HUFA (ω -3) ⁴	43.7	n-3 HUFA (ω -3)	919.2

USSEC 2017, Benicàssim

Searchable transcriptomic databases

www.nutrigroup-iats.org/seabreamdb

www.nutrigroup-iats.org/seabassdb



The screenshot shows the search interface for the *Sparus aurata* transcriptomic database. It includes sections for BLAST search (with a sample sequence provided), annotation search (using words like 'contaminant' or 'GO ID'), and GO ontology search (using GO IDs). The interface is clean with a light blue header and white background.

- 20,565 non-redundant annotated sequences
- 14,535 different gene descriptions

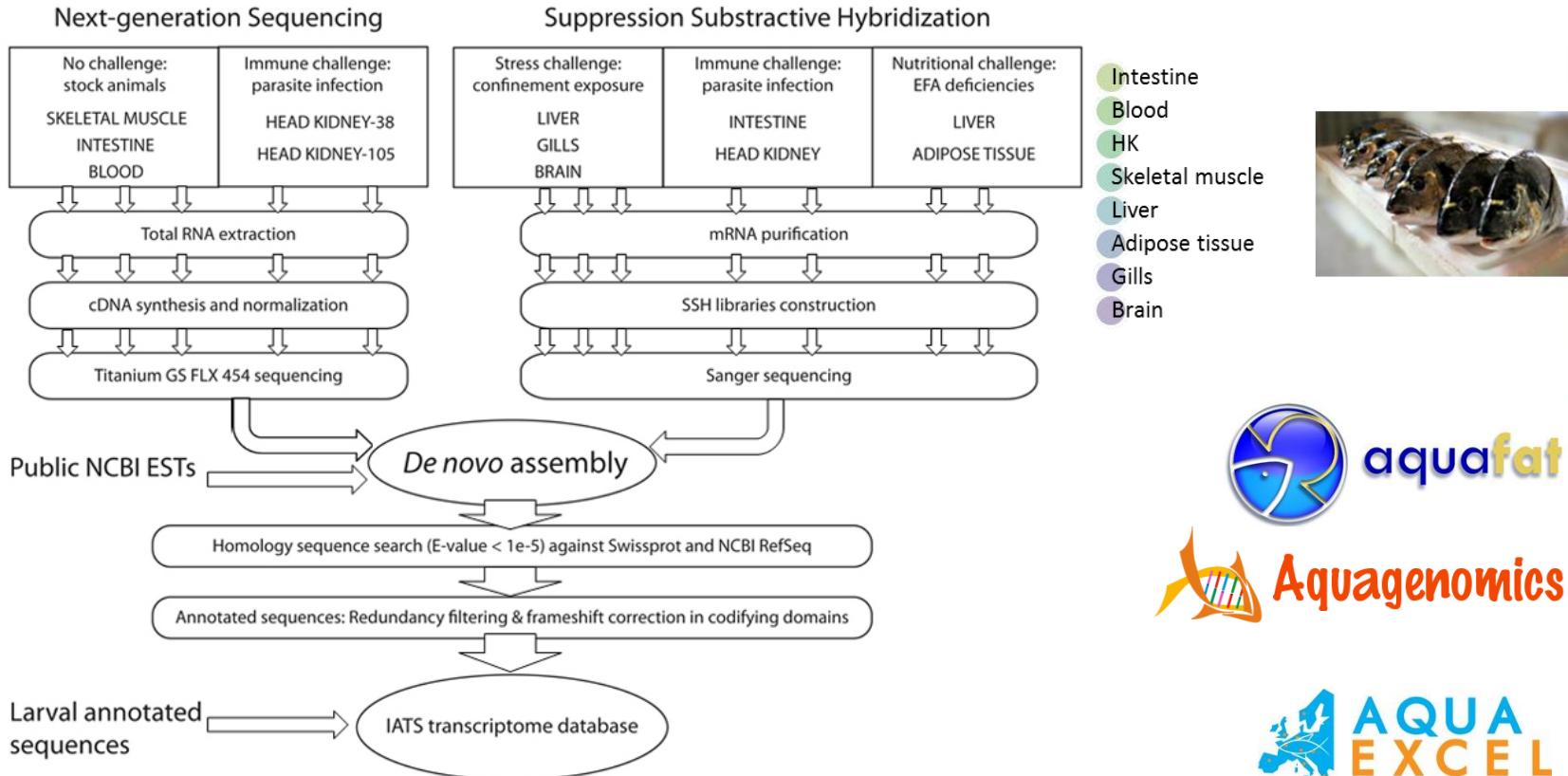
The screenshot shows the search interface for the *Dicentrarchus labrax* transcriptomic database. It follows a similar structure to the first one, with sections for BLAST search, annotation search, and GO ontology search. The database is associated with the ARRAINA project.

- 24,906 non-redundant annotated sequences
- 15,367 different gene descriptions



Sea bream transcriptomic database

www.nutrigroup-iats.org/seabreamdb

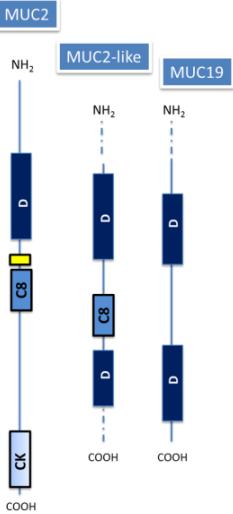


USSEC 2017, Benicàssim

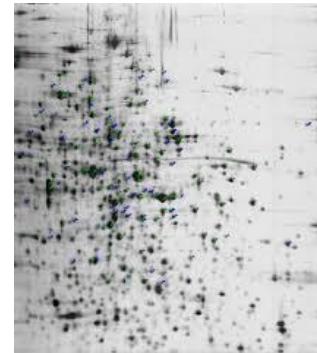
Sea bream transcriptomic database

www.nutrigroup-iats.org/seabreamdb

Secreted gel-forming mucins



Definition of molecular identities and discovery of fish-lineage specific genes (mucins, PRDXs, UCPs....)

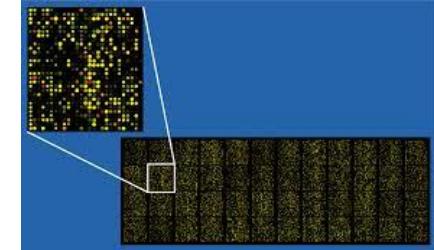


Reference library in proteomic studies

2D-DIGE

iTRAQ

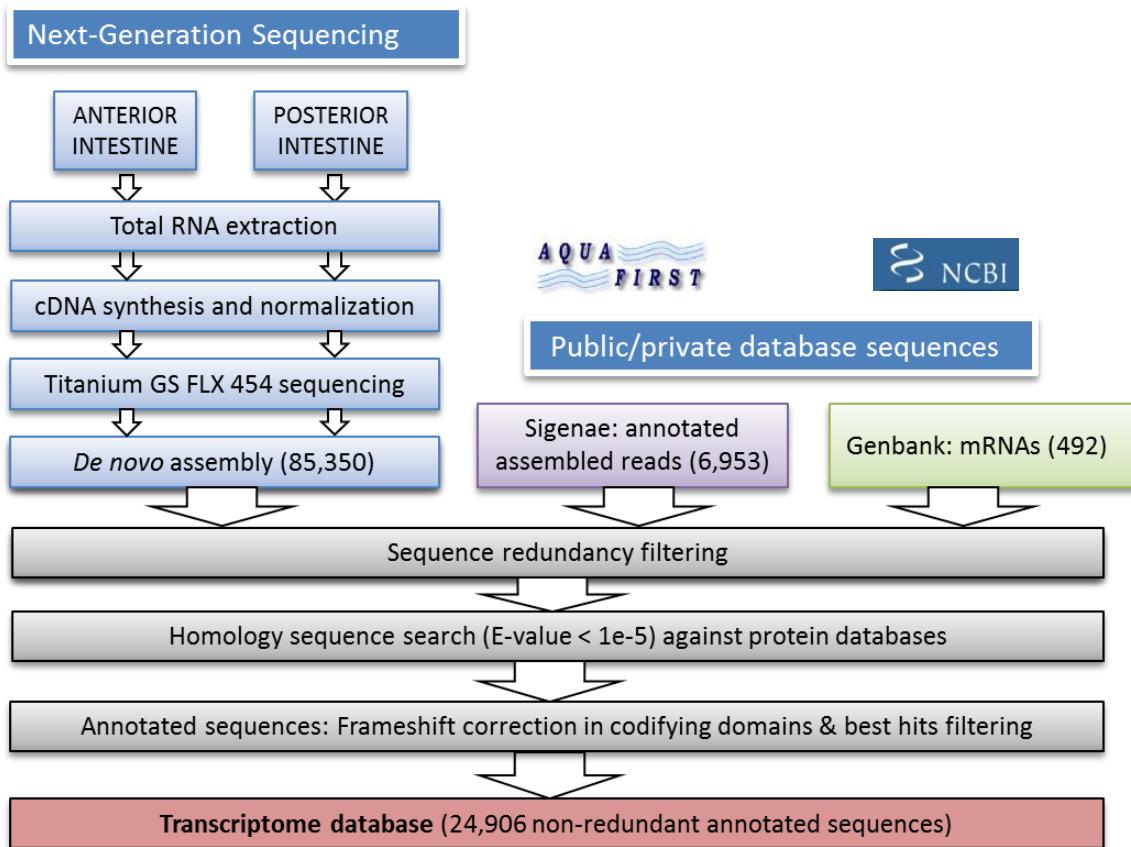
Liver/muscle /intestinal mucus proteomes



Design of microarrays (8 x 15k) and focused PCR-arrays for routine gene expression analyses

Sea bass transcriptomic database

www.nutrigroup-iats.org/seabassdb



Public/private database sequences

Sigenae: annotated
assembled reads (6,953)

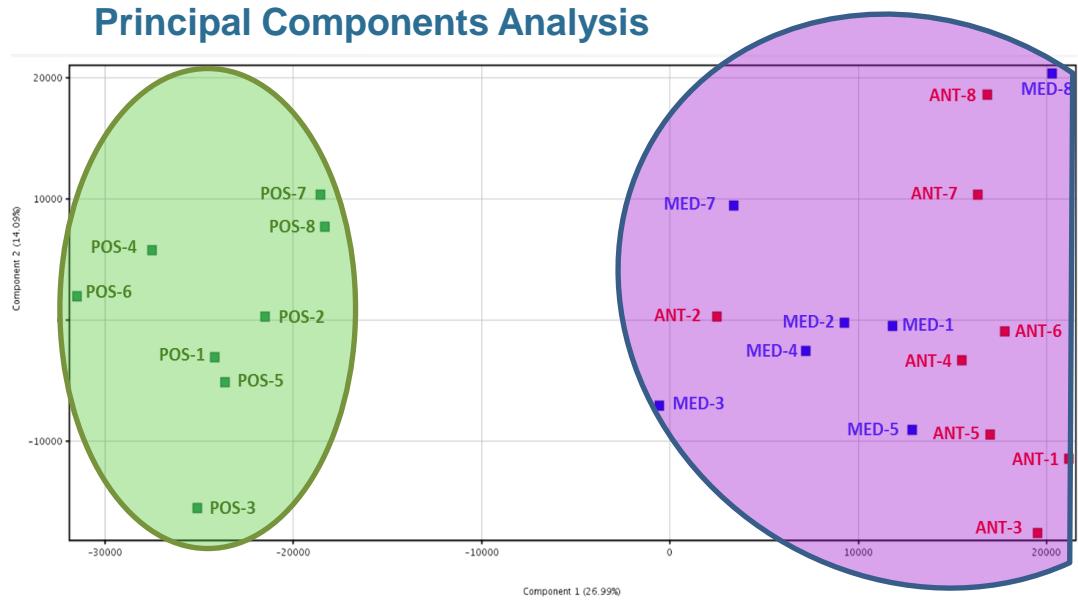
Genbank: mRNAs (492)

Mi2-FISH

Unravelling Metabolic, Intestinal and
Immunopathological Fish Status

SEA BASS MICROARRAY V1: Massive gene expression analysis

Principal Components Analysis



	MID-ANT	POS
MID-ANT	---	960
POS	946	---

MID-ANT vs POS comparison ($P<0.05$, T-test, Benjamini-Hochberg multiple testing correction)



Summary

- Database of biomarkers of traits of interest, nutrient requirements and detection methods of potential contaminants.
- Fillet fatty acid tailoring predictive tool.
- Sea bream and sea bass transcriptomes as the basis of *omic* platforms to phenotype every trait.

IN SILICO TOOLS

Fish species by partners

Carp (HAKI)
Atlantic Salmon (NIFES, UoS)
Trout (INRA)

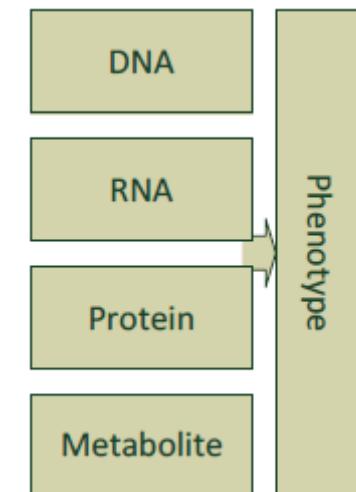
Sea bass (UZHULPGC)
Sea bream (CSIC/CCMARE)

ARRAINA Biomarkers
Identify easy and highly informative nutritionally-regulated biomarkers for the five fish species of the project

Aquafat AGL 2009
What do we eat? Interactive tool for predictive modelling fish fatty acid composition

Sparus aurata transcriptomic database
Data derived from GenBank complete mRNA sequences, a collection of assembled annotated ESTs, and 85,350 new sequences

Dicentrarchus labrax transcriptomic database
Data derived from public repositories of mRNA, collections of ESTs and new high-quality reads from five cDNA 454 normalized libraries





Unravelling Metabolic, Intestinal and Immunopathological Fish Status



PLANT PROTEINS ARE GOOD !!