CELEBRATING 25 YEARS

AquaBioTech Group

ABT Innovia

CAPABILITY STATEMENT

Licensed Aquatic CRO | Vaccine Development & Testing (GMP) | Aquatic Ecotoxicology | Fish Health & Nutrition |

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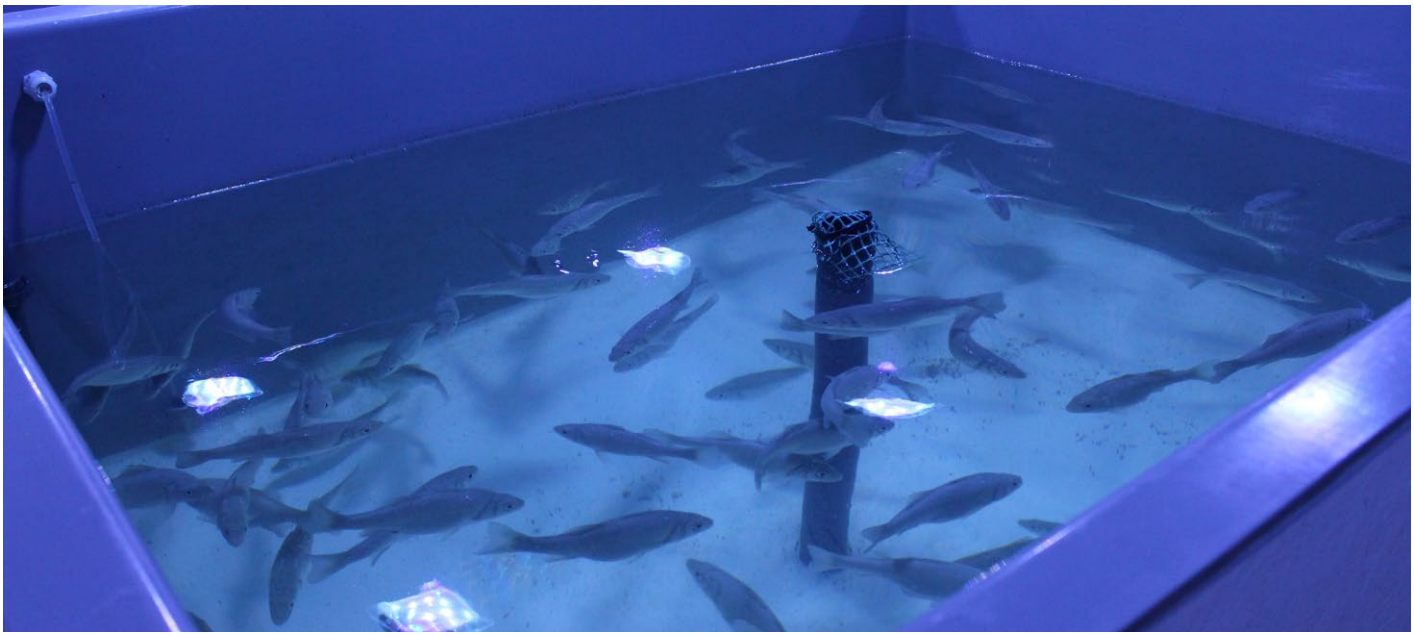

Introduction

With over 20 years of experience carrying out contracted research for the aquaculture industry, ABT Innovia continues to offer its services to companies from all over the world needing to develop and test their products for an ever expanding aquaculture industry.

ABT Innovia carries out research services to support the development and eventual commercialisation of vaccines, functional ingredients, alternative protein sources, culture technologies and production techniques, amongst others, for a wide range of commercially important species under any combination of culture conditions, in its fully licensed and biosecure R&D facilities.

ABT Innovia continues to expand its capabilities to cater for an ever-widening range of research requirements.

ABT Innovia

AquaBioTech Group has continually upgraded and expanded its research and development facilities.

The latest upgrading and expansion phases are now complete, and the new bays are operational, all with their own dedicated drain lines, more energy efficient pumps and the very latest heat-exchange units with increased efficiencies. All systems are lit using photo-controlled LED lighting and each bay has its own specific ventilation unit and computerised water quality monitoring and equipment control system.

Their overall design and finishing enhance sanitation, with epoxy resin floors and walls for ease of cleaning.

As part of the expansion, we have also established a new, dedicated aquatic ecotoxicology laboratory and testing systems for fish, algae and shellfish species.

The facilities wet labs are operated under strict biosecurity practices. Each of the bays contain one or more sets of holding tanks each forming part of a self-contained recirculation aquaculture system (RAS) providing mechanical, chemical, and biological filtration.

Incoming water is filtered down to 1µm and the RAS units are equipped with continuous UV and ozone supply. The RAS can use freshwater or seawater with operational temperatures ranging from 8˚C to 35˚C, allowing flexibility to cater for the culture requirements of practically any species.

Contracted industrial research undertaken for our clients and the company's areas of expertise are:

Aquatic Nutrition Research and Studies

The facility is available to international companies to benchmark commercially available products and carry out investigative research on new products. This includes testing of new formulations with specialised or novel ingredients providing new approaches to improving fish growth, reducing environmental impacts, or improving fish health. In-depth detailed research such as product digestive physiology, metabolic biochemistry, and product quality parameters can also be undertaken at the facility in a wide variety of species.

Veterinarian Research

The veterinarian unit is geared towards undertaking of trials including studies investigating and assessing health related products, such as health promoting additives and vaccine safety and potency. Such trials have been carried out targeting various pathogens; viral, bacterial, and parasitic, in a wide variety of species. The facility has well established challenge models which can be applied depending on the target species and pathogen. However, new models can be tested and established at the request of the client.

Hatchery Technology and Production Techniques

The research facility hosts a live feed section and larval rearing bays, where the latest live feed production, larval rearing technologies and production strategies can be tested to improve hatchery production and rearing efficiency.


B15T7
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ABT Innovia

SYSTEMS **OVERVIEW**

Our facilities currently include trial bays with full recirculation aquaculture systems (RAS) allowing for complete customisation. All bays can be adjusted for fresh water or marine species, for a variety of temperatures and uses as per client requirements.

Our Facilities and Bays

ABT Innovia fully customisable facilities consist of thirty one (31) trial rooms or "bays" with forty-eight (48) individual trial systems and close to five hundred (500) tanks of varying sizes, depending on configuration, which all utilise **AquaBioTech Group**'s RAS technology (ExperiRAS™).

Available tank sizes range from 3L and 1,500L in various quantities and shapes to suit a broad range of trial configurations. The largest bays hold up to thirty-two (32) tanks. We also have Zebrafish systems with up to seventy-two (72) tanks.

ABT Innovia has 31 trial bays and 48 individual trial systems

ABT Innovia services include:

- GMP Vaccine, Safety and Potency Batch Release Testing
- Fish Health Research and Studies
- Fish and Shrimp Nutrition Feed Formulation Research and Studies
- Nutraceauticals
- Larvae Culture, Hatchery Technology
- Ecotoxicology
- Water Quality Assessment
- Bioprospecting Evaluation
- Aqua Technology Testing
- Antifouling / Fouling and Corrosion
- Ornamentals
- Algae and Shellfish
- Offshore Aquatic Testing Sites

ABT Innovia

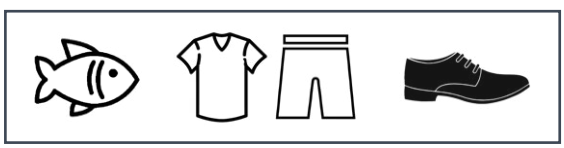
BIOSECURITY AND **MONITORING SYSTEM**

Biosecurity is one of the most important aspects in animal production, since it prevents the introduction, spread and transmission of disease, into, within and between animal production units. Although basic in principle, biosecurity is one of the most challenging aspects of food production, as it encompasses the design, implementation, and monitoring of specific measures at various stages whilst working with animals.

Our facilities operate with a high degree of biosecurity to reduce the risk of pathogen transmission. Our staff are trained in industry leading biosecurity procedures and the work-flows around the facilities are designed to keep biosecurity risks to a minimum.

Some of our biosecurity policy features include:

- Disinfection procedures for entering a bay and equipment use
- Strict access control to each bay
- Constant disease surveillance
- Quarantine procedures for each batch of incoming fish



Monitoring System

ABT Innovia operates an advanced system for continuous measurement, monitoring and control of important water parameters, as well as key operational technologies, as in any of the commissioned commercial hatcheries or fish farms.


AquaBioTech Group

SPECIES AVAILABLE **FOR TESTING**

The **ABT Innovia** research facility can run cost-effective trials with cold water species like Rainbow Trout, and tropical species like Pangasius, Asian Sea Bass and Tilapia. The following is a non-exhaustive list representing species we are able to secure from known sources. However, we are able to facilitate requests from clients to work on other species if required.

Marine

- **Whiteleg shrimp** *(Litopenaeus vannamei)*
- **Atlantic salmon** *(Salmo salar)*
- **European sea bass** *(Dicentrarchus labrax)*
- **Gilthead Sea bream** *(Sparus aurata)*
- **Yellowtail** *(Seriola ialandi)*
- **Red snapper** *(Lutjanus spp.)*
- **Meagre** *(Argyrosomus regius)*
- **Cobia** *(Rachycentron canadum)*
- **Sole** *(Solea solea)*
- **Turbot** *(Scophthalmus maximus)*
- **Coho salmon** *(Oncorhynchus kisutch)*
- **Pomfret** *(Paralichthys olivaceus)*
- **Japanese flounder** *(Paralichthys olivaceus)*
- **Groupers** *(Epinephelus spp.)*
- **Clownfish** *(Amphiprion percula)*
- **Seatrout** *(Salmo trutta)*
- **Red Sea bream** *(Pagrus major)*

Cold - Freshwater

- **Rainbow trout** *(Oncorhynchus mykiss)*
- **Carp / Koi carp** *(Cyprinus carpio)* **- and other species**
- **Tench** *(Tinca tinca)*
- **Perch** *(Perca fluviatilis)*
- **Pike perch** *(Sander lucioperca)*
- **Brown / Sea trout** *(Salmo trutta)*
- **European catfish** *(Silurus glanis)*
- **European eel** *(Anguilla anguilla)*
- **Sturgeon / Sterlet** *(Acipenser sp.)*

New species are added regularly, and on request

Warm - Freshwater

- Nile tilapia *(Oreochromis niloticus)* - and other species
- Asian seabass / Barramundi *(Lates calcarifer)*
- Clarias catfish *(Clarias gariepinus)* & hybrids
- Pangasius *(Pangasius hypophthalmus)*
- Nile perch *(Lates niloticus)*
- Tambaqui *(Colossoma macropomum)*
- Snakeheads *(Channa striata and C. micro-peltes)*
- Angelfish *(Pterophyllum scalare)*
- Zebrafish *(Danio rerio)*

Phytoplankton

- *Pavlova*
- *Isochrysis*
- *Skelotonema*
- *Nanochloropsis*
- *Chlorella*
- *Phormidium*
- *Chaetoceros*
- *Tetraselmis*
- *Thalassiosira*
- *Phaeodactylum*

Shellfish

- Oysters *(Ostreidae)*
- Abalone *(Haliotidae)*
- Manila clams *(Venerupis philippinarum)*
- Limpets *(Patella sp.)*
- Razor clams *(Ensis sp.)*
- Sea urchins *(Paracentrotus lividus)*
- Mussels *(M. edulis and galioprovincialis)*

CRÉDIT D'IMPÔT AGRÉMENT CIR RECHERCHE

Aquatic Ecotoxicology

Acute and Chronic Trials

- Copepods *(Acartia tonsa)*
- Fish - Zebrafish *(Danio rerio)*, Common carp *(Cyprinus carpio)*, Rainbow trout *(Oncorhynchus mykiss)*, Sheepshead minnow *(Cyprinodon variegatus)*, European seabass *(Dicentrarchus labrax)*, Red seabream *(Pagrus major)*, Bluegill sunfish *(Lepomis macrochirus)*, Medaka *(Oryzias latipes)*, Fathead minnow *(Pimephales promelas)*
- Phytoplankton *(Pseudokirchneriella subcapitata, Tetraselmis chui, Skeletonema sp., Phaeodactylum tricornutum, Desmodesmus subspicatus, Navicula pelliculosa)*

Antifouling Efficacy Trials

- Barnacles *(Amphibalanus amphitrite)*
- Mussels *(Mytilus M.galloprovincialis, Branchidontes pharaonis)*
- Bryozoan *(Bugula neritina)*

Live Feeds and other Invertebrates

Live Feeds

- Copepods
- Artemia *(Artemia sp.)*
- Rotifers *(Brachionus sp.)*

Other Invertebrates

- Corals *(Anthozoa)*
- Sponges *(Porifera)*

ABT **CHALLENGE MODELS**

Together with our experienced in-house aquatic veterinarians, **ABT Innovia** has developed models for many disease pathogens that threaten aquatic animal production.

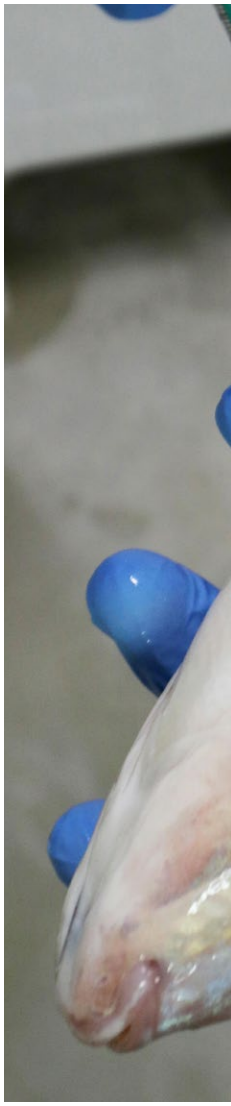
Our facilities have an extensive background working with some of the most relevant diseases affecting fish in aquaculture, such as *Streptococcus agalactiae* in Tilapia as well as other pathogens which are more difficult to work with such as *Flavobacterium psychrophilum* in Trout.

We are continuously working to expand our list of challenge models. Work has been completed on our cohabitation challenge models for *Streptococcosis* in Nile Tilapia (*O. niloticus)* with orally infected fish.

Our Challenge Models Include

Challenge or exposure of pathogens can be done by intraperitoneal injection (IP), intramuscular injection (IM), dip, bath, oral gavage and cohabitation, depending on the species and pathogen.

Environmental stressors can also be applied when required by experimental protocol.



Our Challenge Model List

Bacteria

- European sea bass *(Dicentrarchus labrax)* – *Photobacterium damselae, Vibrio anguillarum, Vibrio harveyi, Aeromonas veronii*
- Gilthead sea bream *(Sparus aurata)* – *Photobacterium damselae, Vibrio anguillarum*
- Rainbow trout *(Oncorhynchus mykiss)* – *Flavobacterium psychrophilum, Aeromonas salmonicida*
- Pangasius *(Pangasianodon hypophthalmus)* – *Edwardsiella ictaluri, Aeromonas hydrophila*
- Barramundi *(Lates calcarifer)* – *Streptococcus iniae*
- Lumpfish *(Cyclopterus lumpus)* – *Aeromonas salmonicida, Pasteurella spp.*
- Nile tilapia *(Oreochromis niloticus)* – Streptococcus iniae, *Streptococcus agalictiae, Aeromonas hydrophila*
- Atlantic Salmon *(Salmo salar)* – *Aeromonas salmonicida, Flavobacterium psychrophilum, Moritella viscosa*

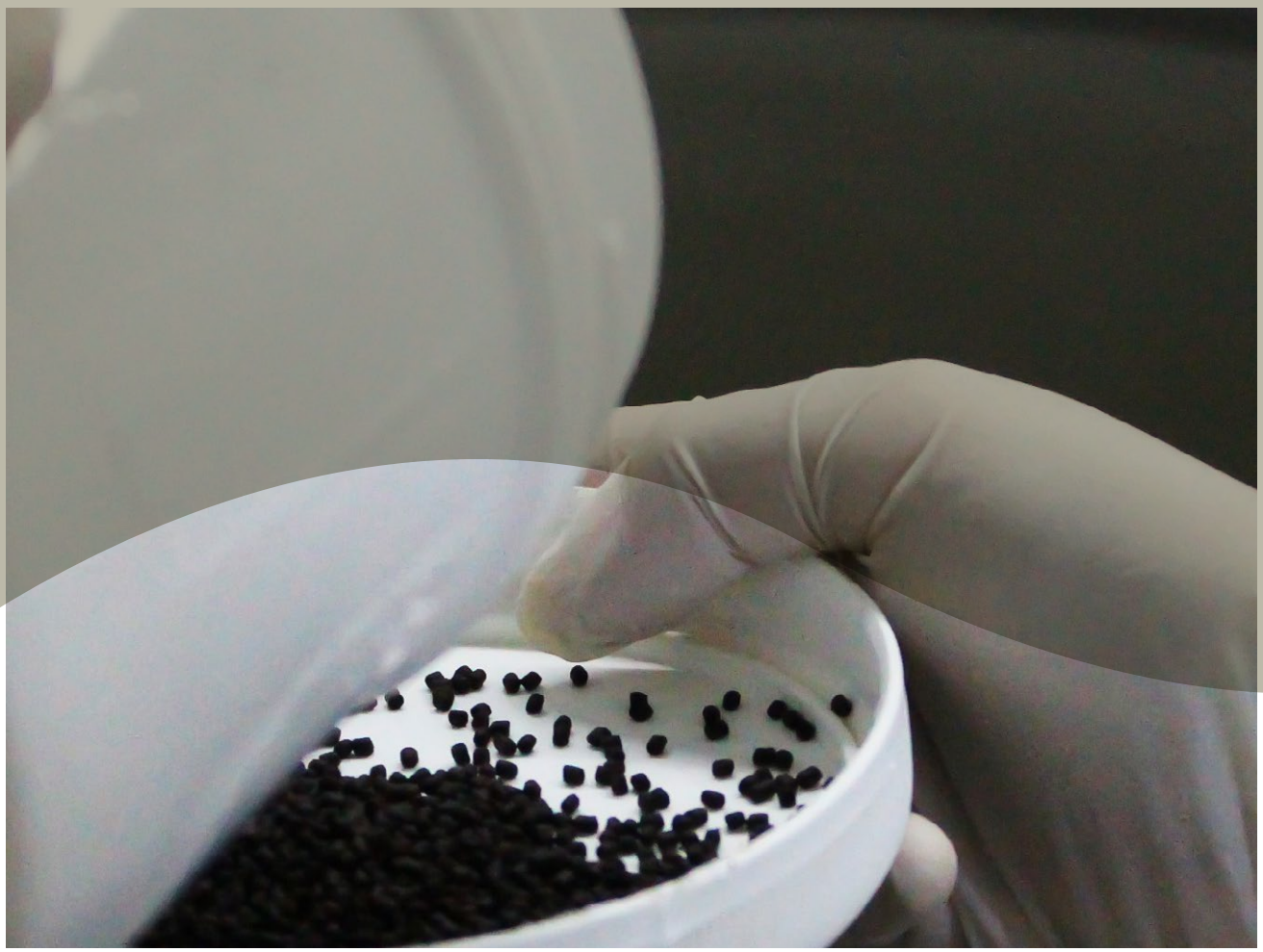
Virus

- European sea bass *(Dicentrarchus labrax)* – Viral Nervous Necrosis (VNN)
- Common carp *(Cyprinus carpio)* – Koi Herpesvirus (KHV)
- Nile tilapia *(Oreochromis niloticus)* – Tilapia Lake Virus (TiLV)
- Whiteleg shrimp *(Litopenaeus vannamei)* - White Spot Syndrome Virus (WSSV)

Parasites

- Gilthead sea bream *(Sparus auratus)* - *Sparicotyle chrysophrii*
- European sea bass *(Dicentrarchus labrax)*- *Diplectanum aequans*

Many new challenge models are under development - please ask for details.



NUTRITIONAL **TRIALS**

Various nutritional trials performed in our facilities:

Feed Formulation Trials

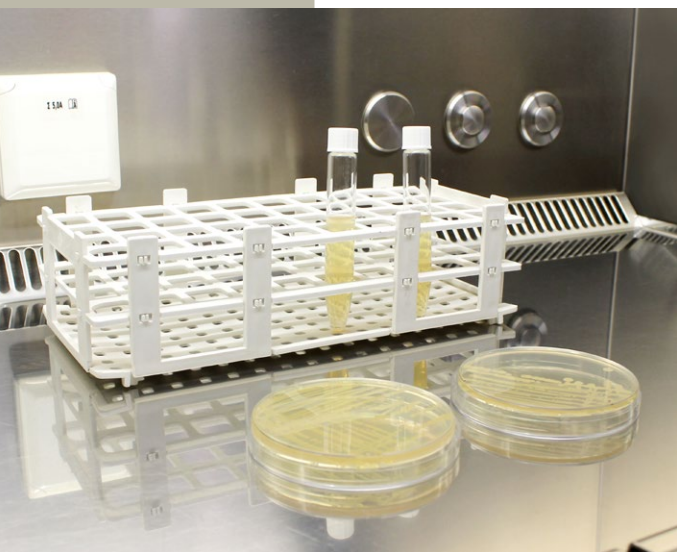
Is when desired raw materials or additives are included at different inclusion levels in experimental diets. Feeds can be formulated by the client or with the help of **ABT Innovia.**

Functional Feed Trials

Is when feeds containing special ingredients are fed to provide a specific benefit (e.g. digestibility, immune status, etc).

Benchmarking Performance Trials

Benchmarking performance trials using different commercially available feeds where fish are grown for a period of time, and biometric parameters are recorded.



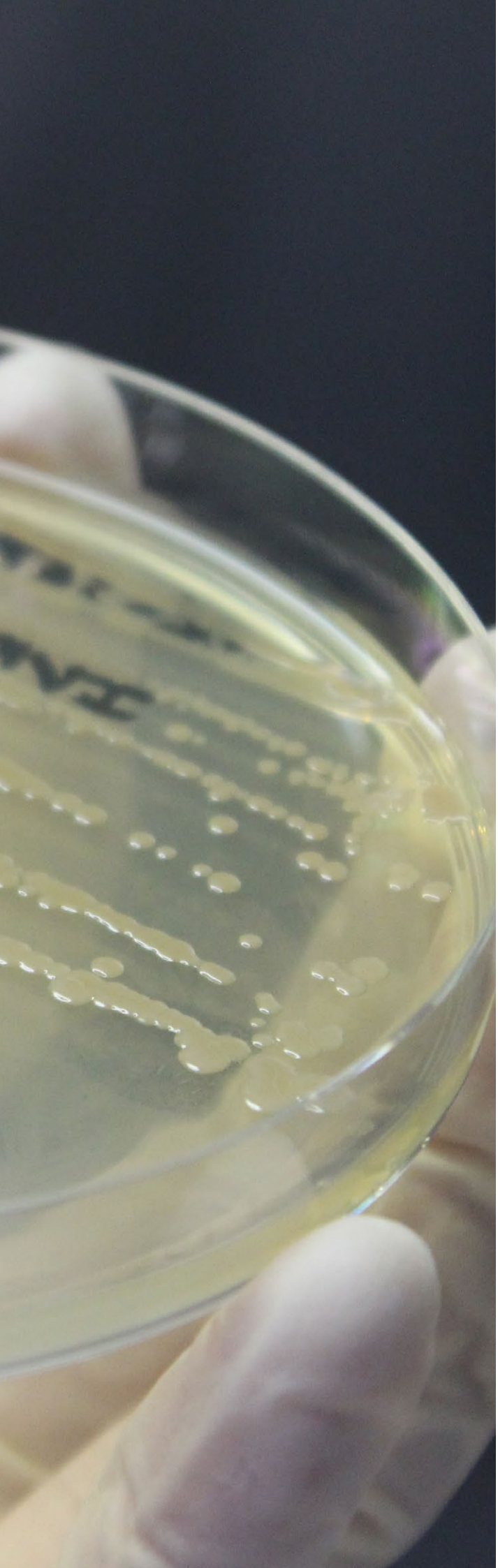
QUALITY **ASSURANCE**

ABT Innovia is a GMP (Good Manufacturing Practice) certified facility, certified by VDR, Malta (Certificate No: AHWD/GMP/01/2022), and also inspected and certified by VSU, Turkey (Certificate No: GMP/TR/V/YD/S0106/2018). **ABT Innovia** is listed at EudraGMP as a site for QC testing, complying with the principles and guidelines of GMP, laid out in Directive 91/412/EEC.

GLP (Good Laboratory Practice) guidelines are followed for environmental toxicity studies on aquatic organisms; studies on behaviour in water, soil and air; bioaccumulation and residue studies.

Laboratory and **Analytical Capabilities**

In our laboratories, and in collaboration with various research centres, we can perform several tests which are useful in the diagnosis and treatment of a disease outbreak.



Diagnosis and Treatments

- Microbiological isolation of bacteria
- Identification by biochemical tests
- Optical microscope classification
- Water quality analysis

Internal Analysis and Practices

- Tagging
- Histology
- Microbiology
- Digital imaging
- General biometry
- Optical microscopy
- Examination via gross necropsy
- Physiological/Biochemical parameters

With Partner Laboratories and Research Centres

- ELISA
- HPLC
- RT PCR
- Respiratory burst
- Sediment analysis
- Heat shock proteins
- Off flavouring geosmin (GSM) and 2-methylisoborneol (MIB)
- Viral isolation and cell culture
- Enzymatic activity at tissue level mRNA expression in specific tissue
- Protein expression in specific tissue
- Proximate analysis (of whole body or target organs)

ABT Innovia

AQUATIC **ECOTOXICOLOGY**

Many regulations require ecotoxicological studies to fulfil applications for registration such as the European REACH regulations of chemicals and the Certification of Bioplastics. The certified ecotoxicology research laboratory uses universally recognised techniques to measure and screen hazardous substances which may be released into the environment.

Areas of Application

- Industrial chemicals
- Veterinary drugs
- Feed additives
- Cosmetic products
- Biocides
- Water analysis

Expertise and Special Skills

- Environmental toxicity studies on aquatic organisms
- Residue studies
- Behavioural studies
- Biochemical parameters
- Endocrine disruption

More Available Species

Algae

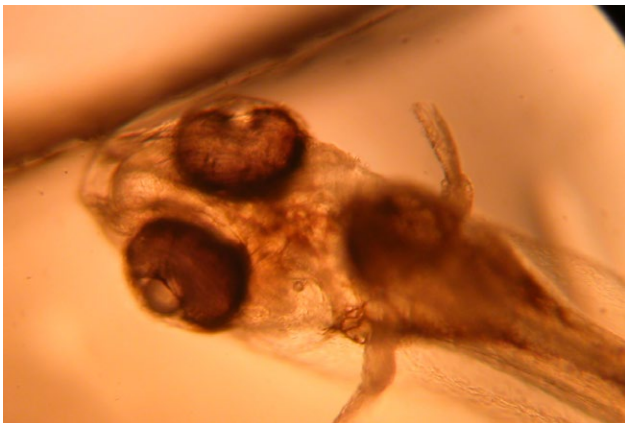
Toxicity tests are assessed in accordance with the latest OECD guidelines. We have extensive experience in the culture and management of several species (microalgae and diatoms). Tests with different species, freshwater, or marine can be established on request.

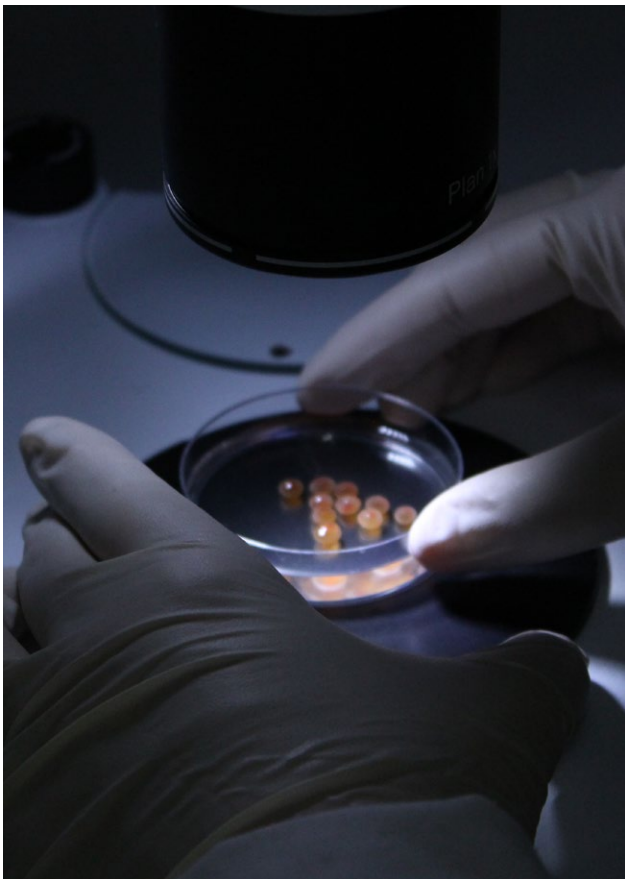
Aquatic Invertebrates

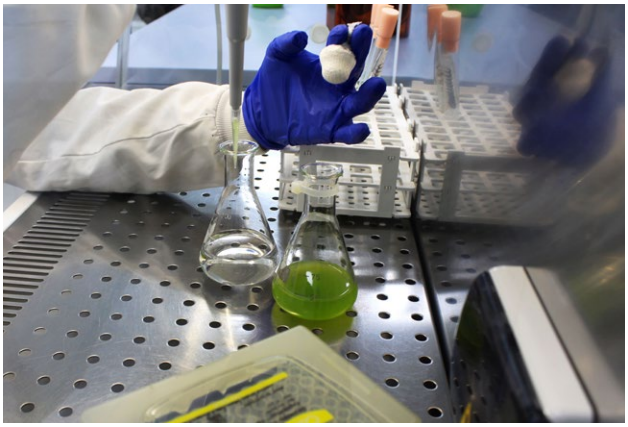
Toxicity tests are available with freshwater and marine species, notably with copepods, brine shrimp and rotifers.

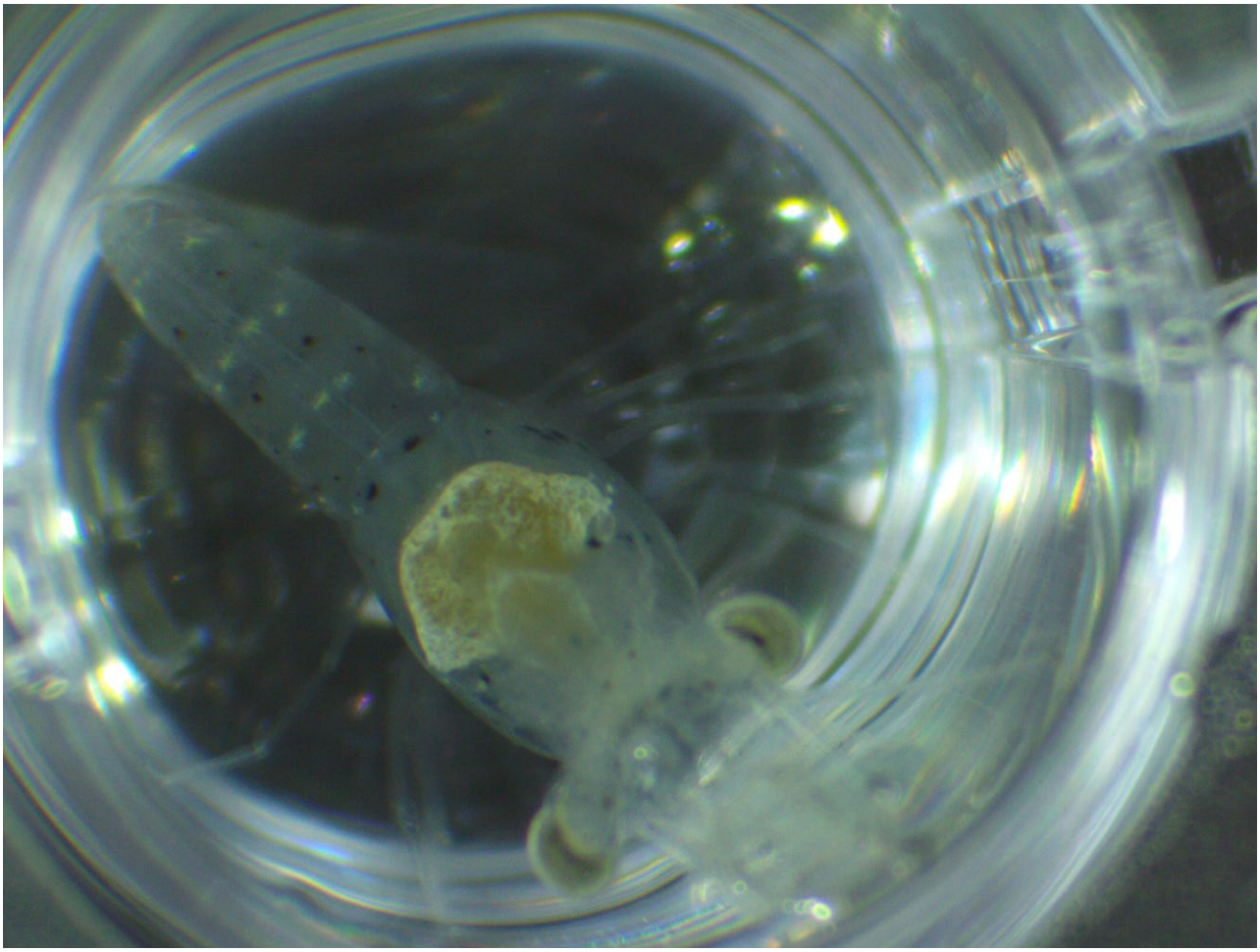
Fish

Working with a wide array of freshwater and marine fish species, acute or chronic studies can be performed in accordance with standard guidelines (OECD 203, 210, etc.). Our wet labs are specifically designed to run large scale short and long-term trials, with a wide range of tank sizes available, from 3L-1500L.









ABT Innovia

ANTIFOULING **EFFICACY TRIALS**

Marine fouling causes enormous problems in the maintenance of vessels, aquaculture cages, ropes, moorings, intake pipelines as well as Reverse Osmosis (RO) plants and other structures. Our licensed facilities provide laboratories, testing tanks and field studies to assess the antifouling efficacy of active substances and antifouling products. In field studies, we provide an in-depth assessment of the antifouling performance using image analysis, attachment strength tests and identification of the fouling community.

Laboratory Screening Tests

Single species bioassays provide a fast and reliable screening method to identify effective active substances and formulations. Bioassays can be done in vitro to test active substances or follow the latest standardised screening test methods (ISO) for efficacy of anti-fouling paints. Micro and macro-fouling model species currently in-house:

- Microalgae, Macroalgae
- Bryozoan, Hydrozoan, Polychaetes
- Crustaceans, Molluscs

Field Tests

- In harbour static field tests (Panels-ASTM D3623-78a, D6990-05)
- Offshore field tests (Nets/ Metallic Demonstrators/ Corrosion testing)

Many commercial antifouling agents are currently being used to combat fouling. However, the main concern remains to fight biofouling without environmental side effects and in a cost-effective manner.

ABT INNOVIA

Animal **Welfare**

Aquatic organisms are faced with many threats to their health through natural exposure to stresses and challenges. At **AquaBioTech Group** we are constantly striving to advance scientific understanding of how technology, nutrition and health management can help fish, shrimp and other aquatic species resist and recover from illness, stress, and disease.

Optimising the health status is essential for maintaining fish welfare and for achieving optimum growth of aquaculture species; research plays a key role in accomplishing these goals. The ethical and humane treatment of all animals in our care is of the highest priority, and therefore we implement the **three "R's"** principle:

Replacement

Refers to methods that avoid the use of animals, or at least replacing those animals that are used in research. When discussing research needs with clients, **AquaBioTech Group** encourages clients to identify alternatives to animal testing such as in vitro methodologies.

Reduction

Refers to methods which minimise animal use and enable researchers to obtain comparable levels of information from fewer animals or to obtain more information from the same number of animals.

When designing experiments, **AquaBioTech Group** will attempt where possible to reduce the number of animals used.

This can include:

- Reutilize experimental animals when no increased risk of pain, suffering or lasting harm is foreseen
- Avoid unnecessary testing by carrying out appropriate research (e.g., literature research)
- Improving experimental design and statistical analysis

Refinement

Refers to improvements in scientific procedures and husbandry practices which minimise actual or potential pain, suffering, distress or lasting harm and/or improve animal welfare in situations where the use of animals is unavoidable.

When conducting experiments, **ABT Innovia** will provide the highest standards of care and husbandry to the experimental animals:

- Implementing the use of non-invasive techniques where possible
- Maintaining appropriate and optimal husbandry conditions
- Ensuring that suitable humane endpoints are identified

WHO WE ARE

Divisions within **AquaBioTech Group**

Within **AquaBioTech Group** there are various divisions that focus on different business areas such as:

ABT Aquaculture

ABT Aquaculture is the consulting division of the company for all aquaculture related projects. Established as a provider of due-diligence and risk assessments for all forms of aquaculture operations, as well as consulting on operational issues and improvements in hatcheries, fish farms, research facilities and processing facilities.

Offshore Aquaculture
We provide a complete service from project design through to installation and commissioning. Projects of all sizes are undertaken, including assistance in procurement of equipment, technologies, and staff for new projects. Experienced in designing offshore aquaculture projects for some of the most exposed sites, our engineers work with cage manufacturers and mooring experts to safely move fish farms further offshore.

Land Based Aquaculture
With extensive global experience in the design and construction of Recirculation Aquaculture Systems (RAS) for new projects and retrofits, offering a wealth of knowledge, assisting in management and monitoring of land-based production facilities.

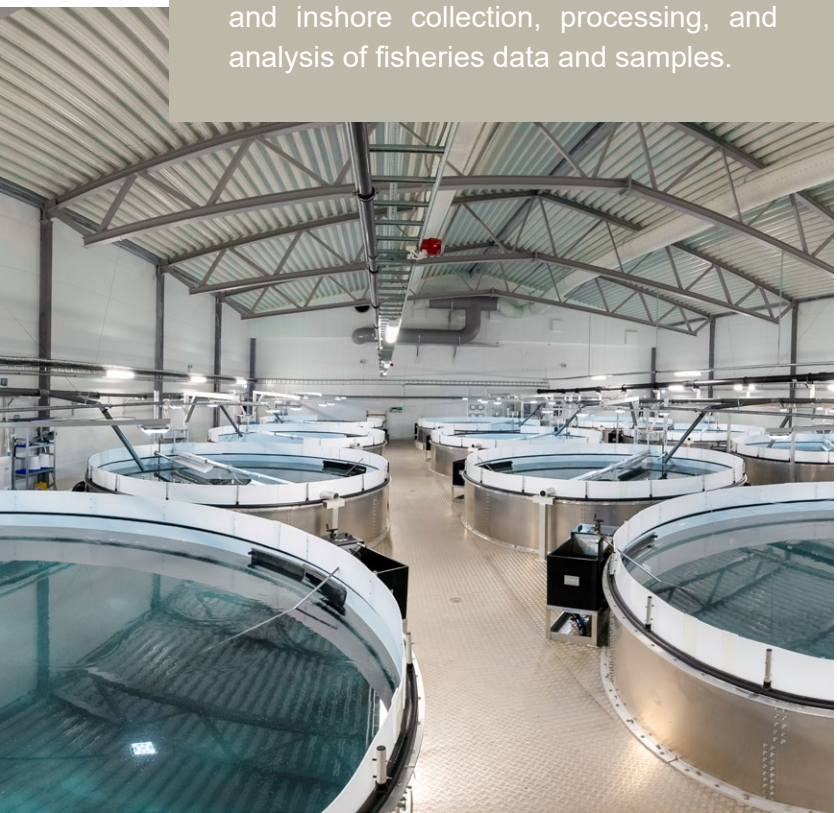
Our company undertakes a variety of different RAS projects including full project engineering, through to specific biological aspects of production systems for mainstream and emerging species. All projects include an online monitoring system that allows our staff to continuously monitor the system's performance from our head office.

ABT Marine

ABT Marine provides a range of services including marine surveying, remote operated vehicle (ROV) search and rescue missions, habitat mapping, and GIS analysis. The skills and techniques employed include subsea sediment and water quality assessments, bathymetric and side scan sonar surveys, ROV investigations, and site inspections using remote sensing, underwater video techniques and SCUBA diving.

ABT Fisheries

ABT Fisheries offers a broad range of services in fisheries science. Our expertise encompasses several disciplines enabling us to carry out research, conservation, and commercial activities. We undertake projects in collaboration with international research institutions, governmental agencies, NGO'S and the private sector. We provide a complete set of multilevel field surveys, and is specialised in offshore and inshore collection, processing, and analysis of fisheries data and samples.



ABT RAS

AquaCirc™ has developed several highly efficient and cost-effective RAS. The system developed by **AquaBioTech Group** is a unique recirculation system which combines numerous state-of-the-art recirculation apparatus, such as specifically designed tanks, Glass Reinforced Plastic (GRP) fibreglass products, specialist products and saturation cones.

With almost twenty years of experience of RAS experimental research, with many different species of fish (and other aquatic animals) in our R&D facility in Malta, **AquaBioTech Group** has gained vast knowledge on fish nutrition, fish health, fish behaviour, and in-depth understanding of fish husbandry. As a result, **AquaBioTech Group** developed **ExperiRAS™** which is customised to match client needs. The **ExperiRAS™** system design is a result of the work of **AquaBioTech Group**'s engineers and architect, each offering a wide variety of skills, including mechanical engineering, industrial automation and wastewater treatment.

ABT Innovia

CAPABILITY STATEMENT

Created by **AquaBioTech Group**

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