Deliverable No. 3.2

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AquaVitae

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New species, processes and products contributing to increased production and improved sustainability in emerging low trophic, and existing low and high trophic aquaculture value chains in the Atlantic

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Deliverable D3.2

Report on first development phase in case studies WP3

21/04/2021

Executive Summary

The objectives of AquaVitae's WP3 is to develop new products from the selected aquaculture Value Chains (VC) and Case Studies (CS). Everything that can be sold, value added or processed qualifies as a product. Different from WP1 and WP2, it relates only to post-harvest – mainly products that are, or can be, produced based on low trophic species (LTS), including new and existing feed formulas and diets for high trophic species. This deliverable reports on the first development phase (M1-M12) for all of these.

The CS Reports were completed and recorded through a coordinated effort of WP1, 2 and 3 (Appendix 1), using a database that was specifically designed (Appendix 2), these data were made easily accessible and useable. Both the reporting template (Appendix 1) and the database tool (Appendix 2) were central element of the methodology used to gather the information needed to assess the progress of the 13 CS.

All detailed planning, scientific, technical and innovation information for each CS which advance the completion of WP3 tasks are presented in Annex 3 of Deliverable D1.1 (CS specific work plans) and in Annex 3 of D1.2 (Detailed Case Study Reports (M1-M12)). Annex 3 of D1.2 specifically contains an abstract/summary for each CS. The Case Study Reports (M1-M12) detail the methods used and results obtained. Where applicable the results are discussed. In a final section the progress, deviations, problems/solutions and planned future outlooks for next 12 months are provided.

Eleven of the 13 CS produced outputs that contribute to the main task of WP3. These includes CS1-8 and 11-13. The main result of this deliverable is a complete overview of all 42 exploitable outputs and their requirement specifications that relate to WP3. These include one process, two reports and 39 tangle products. They range from new processes for aquaculture production, to products that include low trophic species (LTS) for human consumption, aquafeeds for high trophic species and the use of LTS in alternative products (such as paint). This report demonstrates the identified exploitation potential of these outputs, and highlights the current status of the up- and coming product developments within AV.

The percentage completes of the tasks that report to WP3 ranged from 0% (for tasks that were not scheduled to start in the first 12-months) to 95% complete, for work that have been run ahead of schedule. Most of the tasks that report to WP3 were 20% complete or less, which is largely in-line with the progress expected after a quarter of the way throughout this 48-month project.

The main users of this deliverable will be the leaders of WP1-3, WP5-7 scientists, WP9 participants and the CS leaders. The information summarised here will be used by the project participants to select industry partner(s) (known or networked) for product testing and business-to-business (B2B) feedback collection; a process that will be developed in the coming months of this project.

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1. Introduction

i. Synopsis AquaVitae

AquaVitae is a research and innovation project funded by the EU's Horizon 2020 programme. The project consortium consists of 35 partners, from 16 different countries, spread across four continents. In addition to Europe, partners are situated in countries bordering the Atlantic Ocean, including Brazil, South Africa, Namibia, as well as in North America. Its broad aim is to introduce new low trophic species, products and processes in marine aquaculture value chains across the Atlantic.

ii. Scope and motivation of D3.2

The objectives of AquaVitae's WP3 is to develop new products from the aquaculture value chains (VC) under investigation in the project, i.e.

VC1 Macroalgae
VC2 IMTA
VC3 Echinoderm
VC4 Shellfish
VC5 Finfish

This includes products originating from waste material or by-product utilization processes, the use of low trophic species as raw material to produce feed for high trophic species or value-added products for other industries, new technologies, tools or processes. Everything that can be sold, value added or processed.

Deliverable 3.2 presents the outcome of the first development phase (M1-M12) of those CS that have or will produce outputs related to the objective of WP3. It summarizes these outputs, presents their requirement specifications and demonstrates the identified exploitation potential to date.

All detailed scientific, technical and innovation information for each CS which advance the completion of WP3 tasks are presented in Annex 3 of D1.2 (Detailed Case Study Reports (M1-M12)).

2. Report on first development phase for new or improved products in CSs, including requirement specification

i. Methodology

Following the spiral model of innovation methodology (see figure 1 of D1.1) CS leaders have completed their first innovation loop and reached a first prototype stage. Here, a prototype translates to any sort of output from a CS, may that be a new or improved product (including new species & technical hardware), process or a report.

To gather the necessary information for this deliverable, three tools were used:

firstly, the completed Case Study reports that used the "*CS Report Template"* (Appendix 1, D1.2) that was completed by CS leaders at month-6 and month-12, and will be updated at 6-monthly intervals for the duration of the project;

secondly, a new Excel tool developed by the leaders of WP1-3 to make the entire dataset of the progress made by all 13 CS more manageable and available – the "*AquaVitae WP 1 - 3 database"* (Appendix 2, D1.2). In order to clearly match the work and outputs of all case studies with the best fitting WP (WP1-3), the terminology used within AV and the database was refined and explained in D1.2;

thirdly, a technical case study report for the work from M1-M12 that was filled in by all CS partners (Appendix 3 of D1.2).

To generate the tables summarizing the outputs of the first development phase, a number of filters were set in the database. This allowed extraction of the information specific to WP3. The product specifications were requested by email from all partners and added to the tables.

ii. First development phase for new or improved products in CSs

A report on CS task level detailing all scientific and technical findings during the first development loop can be found in Annex 3 of D1.2 (Detailed Case Study Reports (M1-M12)). It specifically contains an abstract/summary for each CS. The Case Study Reports (M1-M12) detail the methods used and results obtained. Where applicable the results are discussed. In a final section the progress, deviations, problems/solutions and planned future outlooks for next 12 months are provided.

The database helped in creating a list of outputs. There were 43 potential, exploitable outcomes identified by the CS in AV (Table 1). Each outcome was assigned a specific identifier, type category, a detailed explanation describing the outcome, its requirement specifications, and the potential for becoming a future sellable product, the level of completeness with regard to what is expected by the end of the project, the current technology readiness level (TRL) and the WP task(s) that it reports to.

Table 1: All outputs related to WP3 and their requirement specifications (with: CS = corresponding Case Study Number; Ident. = specific identifier; Pot. Product (Y/N/tbc) = potential for becoming a future sellable product (Yes, No, to be confirmed); Complete = level of completeness with regard to what is expected by the end of the project; current technology readiness level (TRL); WP task = task(s) the output reports to according to description of action)

CS	Ident.	Output type	Detail	Requirement Specifications	Pot. Product (Y/N/tbc)	Complete	Current TRL	WP task
1	1.5.1	Report	Composition of commercially cultivated new species	EU nutrition labelling for foodstuffs	tbc	0% This task will start on M31	4	T3.2
3	3.3.2	Product	Anemone production	Production of anemone (*Anemona sulcata*)	Y	80% Based on the current status of the experiment, the task is 80% completed. The experiment is running and the results are being collected and analysed. The restrictions due to the COVID crisis did not affect the collection of data in terms of growth, survival and biomass production.	3/4	T3.2
	3.5.1	Product	New sea cucumber species optimized for shore based IMTA.	Produce new sea cucumber species in Land based IMTA system integrating abalone/macroalgae and sea cucumbers.	Y	20% Part of the data (both from CS Task 3.5 and CS7) for the life cycle assessment (LCA) was collected. Based on the current status and development of the trial, it is estimated that the task is 20% completed. Pre-trial on diurnal water quality dynamics on South African abalone farm was completed. Data collected in the pretrial will be used in the experimental design of the main trial that will be reported on after the LCA has been carried out.	3/4	T3.2
	3.8.1	Report	Analysis of the products in terms of quality, sustainability and nutritional value.	Analyse quality and nutritional value of IMTA products to consider their interest as new/improved products for consumption or use.	tbc	0% Task is scheduled to start in M25	4/5	T3.2

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CS	Ident.	Output type	Detail	Requirement Specifications	Pot. Product (Y/N/tbc)	Complete	Current TRL	WP task
4	4.2.2	Product	Mussels produced using IMTA in South Africa	Mussel production with reduced environmental footprint; production method will adhere to all industry and environmental specifications.	Y	80% This case study task (CST) is approximately 80% complete. Phase 1 and Phase 2 of the task have been achieved ahead of plan and Phase 3 (although not part of the initial work plan – and will constitute additional value) is scheduled to begin in M13. The lessons and knowledge gained from Phase 1 and 2 of this study will be used to further develop and refine methods to test the feasibility of IMTA of Gracilaria and mussels within the unique location of Saldanha Bay, South Africa.	5	T3.2
	4.2.3	Product	Macro-algae produced using IMTA in South Africa	New product that was not previously produced; improved use of existing infrastructure.	Y	80% See above	5	T3.2
	4.6.1	Product	Abalone obtained in IMTA with seaweed.	Process will contribute to reduce environmental footprint of aquaculture production methods and will make production more cost-effective; contribute to developing new industry standards.	Y	40% The work achieved during the first 12-months is going well beyond what we could expect to achieve and can be estimated to be 40% complete. The progress towards the main key exploitable result of this task is well on its way: a seaweed production at sea alongside the abalone farm should allow for the production of a significant amount of food for the abalone. The first step in order to assess seaweed culture at sea was to secure the supply of young seaweed plantules at reasonable price and was achieved. Several methods for deployment were tested (on horizontal and vertical long line, directly on the cage). A batch of seed was produced under organic standard specifications using organic nutrients. Sporulation protocol was very satisfactory. Preculture was also a success. Longline culture has obtained mixed so far results. Cultivation on the outer sides of abalone cages was unsuccessful due to a severe winter storm.	5	T3.2

CS	Ident.	Output type	Detail	Requirement Specifications	Pot. Product (Y/N/tbc)	Complete	Current TRL	WP task
	4.6.3	Product	*Alaria esculente* obtained in abalone IMTA co-culture.	Process will contribute to reduce environmental footprint of aquaculture production methods and will make production more cost-effective; contribute to developing new industry standards.	Y	40% See above	5	T3.2
	4.6.4	Product	*Palmaria palmata* obtained in abalone IMTA co-culture.	Process will contribute to reduce environmental footprint of aquaculture production methods and will make production more cost-effective; contribute to developing new industry standards.	Y	40% See above	5	T3.2
	4.7.1	Product	Queen scallop obtained from abalone IMTA co-culture.	Queen scallop culture in benthic sea cage is new in Europe and in co-culture it may prove valuable to diversify the production and reduce its impact. It may also improve productivity through the use of phytoplankton in water.	Y	10% This task started a little behind schedule. Scoping and planning were done. Structures have been prepared, so that we assume the task to be complete by 10%. But since then, the task has been delayed as seed-stock cannot be obtained due to confinement as a result of COVID-19. There is sufficient time to catch up on the progress that has been lost here.	4	T3.2
	4.7.2	Product	Flat oyster obtained from abalone IMTA co-culture.	Flat oyster culture in benthic sea cage in co-culture may prove valuable to diversify the production and improve productivity through the use of phytoplankton in water.	Y	10% See above	4	T3.2
5	5.1.2	Product	Shrimp grown by new biofloc system.	High-quality shrimp produced in a sustainable intensive biofloc system without the use of chemicals like antibiotics.	Y	40% Based on the results obtained we consider this task to be complete by about 40%. We executed two experiment and one more experiment and the evaluation of the prototype are still to be done.	5	T3.2
	5.2.2	Product	Shrimp grown by new IMTA Biofloc system.	High-quality shrimp produced in an intensive sustainable IMTA system without the use of chemicals like antibiotics.	Y	35% Based on the results obtained we consider this task to be complete by about 35%. We executed two experiments. Two more experiments and the evaluation of the prototype remain to be done.	5	T3.2

CS	Ident.	Output type	Detail	Requirement Specifications	Pot. Product (Y/N/tbc)	Complete	Current TRL	WP task
	5.2.3	Product	Mullet grown by new IMTA Biofloc system.	High-quality fish produced in an intensive sustainable IMTA system without the use of chemicals like antibiotics.	Y	35% See above	5	T3.2
	5.2.4	Product	Ulva sp. grown by new IMTA Biofloc system.	High-quality seaweed produced in an intensive IMTA sustainable system without the use of chemicals like antibiotics.	Y	35% See above	5	T3.2
	5.3.2	Product	Shrimp grown by new IMTA system.	High-quality shrimp produced in an extensive organic IMTA sustainable system without the use of chemicals like antibiotics.	Y	25% Based on the results obtained we consider this task to be complete by about 25%. We executed one experiment and two more experiments and the evaluation of the prototype are still to be done.	5	T3.2
	5.3.3	Product	Oyster grown by new IMTA system.	High-quality fish produced in an extensive organic sustainable IMTA system without the use of chemicals like antibiotics.	Y	25% See above	5	T3.2
	5.3.4	Product	Seaweed grown by new IMTA system.	High-quality seaweed produced in an extensive organic sustainable IMTA system without the use of chemicals like antibiotics.	Y	25% See above	5	T3.2
6	6.1.2	Process	Land based holding system for sea urchin roe enhancement.	The output will be split into two types: (1) Commercial prototype (commercially sensitive) of a land-based raceway system with an integrated tipper self-cleaning system. Testing this system will be part of the project output (Norway) (2) Tech Transfer: Land-based holding system design parameters (e.g. raceway and inlet water designs) to enable industry to run sea urchin roe enhancement trials (Spain).	Y	12% (1) Based on the results obtained to date we believe we are approximately 12% complete in the task of system installation and delivery of enhancement protocols. The transport protocols will be investigated further in future trials. The tipper tank system will be a key exploitable result once fully tested. (2) Based on the results obtained to date we believe we are approximately 12% complete in the task of system installation and delivery of enhancement protocols.	4	T2.2, T3.2

CS	Ident.	Output type	Detail	Requirement Specifications	Pot. Product (Y/N/tbc)	Complete	Current TRL	WP task
	6.2.1	Product	Production of new species *Strongylocentrotus droebachiensis* from a new process (roe enhancement and out of season production).	The roe from wild caught *Strongylocentrotus droebachiensis* is sold extensively in a number of markets around the world including Asia and Europe. The product standards are clearly defined. However, enhanced roe from wild caught sea urchins fed feeds over 2-3-month periods has never been marketed and sold. The aim of this output is to produce high quality sea urchin roe (of at least the same quality, if not higher quality than wild caught roe) in a 2-3-month period from sea urchins collected from that are in poor quality using specifically designed feeds.	Y	12% Based on the results obtained to date we put the %completeness of this Task at 12%. The production of enhanced roe from *S. droebachiensis* will form a key exploitable result of this task. Unfortunately, due to COVID-19 the first market testing was cancelled but limited taste testing was carried out by URCHINOMICS.	4	T3.2
	6.3.1	Product	Production of new species *Paracentrotus lividus* from a new process (roe enhancement and out of season production).	The roe from wild caught *Paracentrotus lividus* is sold extensively in a number of markets around the world but mainly in Europe. The product standards are clearly defined. However, enhanced roe from wild caught sea urchins fed feeds over 2-3-month periods has never been marketed and sold. The aim of this output is to produce high quality sea urchin roe (of at least the same quality, if not higher quality than wild caught roe) in a 2-3-month period from sea urchins collected from that are in poor quality using specifically designed feeds.	Y	12% Based on the results obtained to date we calculate the % completeness of the CST to be 12%. The results showed there are major changes required to the harvesting and transport techniques used for sea urchins to be enhanced. This species also appeared to show a clear reluctance to start feeding in the enhancement system but it was uncertain if this was due to the initial stress they were exposed too or whether this was a behavioural characteristic of the species. This must also be considered in future trials. The key exploitable result from this task will be the production of enhanced sea urchin roe from P. lividus. Limited progress has been made at this point.	3	T3.2

CS	Ident.	Output type	Detail	Requirement Specifications	Pot. Product (Y/N/tbc)	Complete	Current TRL	WP task
7	7.3.2	Product	Holding facilities for sea cucumber IMTA with Abalone.	The technical requirements of holding facilities for sea cucumber in combination with Abalone are unexamined. It is clear that specific holding systems (possibly cages, structure or nets) will be required in the long term to ensure the integration is successful in terms of animal retention and in terms of controlling interactions between abalone and sea cucumber. These physical technologies will be patentable and will be applied in multiple farms.	tbc	5% This task is on schedule in South Africa. GSI data will take 12-months, but the capacity for collection and upcoming spawning work is present. This task is only 5% complete as a full year of monthly samples must be collected. Currently we have only one preliminary dataset for a month and we have established methods.	4	T3.2
	7.3.3	Product	Bêche-de-Mer from *Neostichopus grammatus* (from IMTA).	Bêche-de-Mer is the dried body wall of sea cucumber and is the main form of export-quality sea cucumber destined to be sold in Hong Kong and/or mainland China. These products are graded and sorted by many different characteristics including; size, shape, spikiness/smoothness, wall thickness and colour. The valuation of the product is extremely nebulous, but will need to be clarified together with providers and with consumers as far as possible to establish the value of the species *Neostichopus grammatus* (from IMTA) as a sea cucumber export.	Y	5% See above	4	T3.2
	7.3.4	Product	Bêche-de-Mer from *Holothuria grisea* (from IMTA).	Bêche-de-Mer is the dried body wall of sea cucumber and is the main form of export-quality sea cucumber destined to be sold in Hong Kong and/or mainland China. These products are graded and sorted by many different characteristics including; size, shape, spikiness/smoothness, wall thickness and colour. The valuation of the product is extremely nebulous, but will need to be clarified together with providers and with consumers as far as possible to establish the value of the species *Holothuria grisea* (from IMTA with oyster) as a sea cucumber export.	Y	5% See above	4	T3.2

CS	Ident.	Output type	Detail	Requirement Specifications	Pot. Product (Y/N/tbc)	Complete	Current TRL	WP task
8	8.2.2	Product	A new software for automatic identification of oyster species	A new system for automated identification of oyster spat by species.	Y	5% Progress in Sweden is as anticipated and in accordance to the plan. Pictures of oysters of both species and of unsure individuals have been collected and the unsure individuals have been sent for genetic identification of species.	4-5	T3.2
11	11.2.1	Product	Diet development for juvenile Brazilian flounder, for larvae	The diet will have a pellet quality (e.g. density, durability, hardness, water stability), size, and shape suitable for the species and stage.	Y	20% The feeding experiment was carried out before it was scheduled. Five protein levels were evaluated, all diets had the same lipid level and were isocaloric. The trial with fish ended well and carcass samples were collected and stored frozen. We did not have the opportunity to finish analysing these samples, but we are expecting clearance of the university in order to finish processing these samples. Once this is done, the task will be completed and a manuscript will be ready for publication. Based on the results obtained so far and detailed above, we consider to have achieved around 20% completeness for this task.	4	T3.2
	11.3.1	Product	Diet development for juvenile Brazilian flounder, for grow out with protein sparing effect	The diet will have a pellet quality (e.g. density, durability, hardness, water stability), size, and shape suitable for the species and stage.	Y	0% Due to Covid-19 this task was put on hold and this experiment was not started.	4	T3.2
12	12.2.2	Product	Ecological paint manufacturing.	Industrial application of $CaCO_3$ from shellfish aquaculture, consisting on substituting mineral by shellfish $CaCO_3$ as a primary extender. This paint application will contribute to shellfish $CaCO_3$ sequestration for decades. Shellfish $CaCO_3$ production and needs of the paint industry are balanced in Galicia.	Y	5% Thermal and chemical procedures have been tested to remove the shell protein matrix as a first step to purify the CaCO3 in mussel shells Subsequently, shell CaCO3 has been ground in a ball mill. Only very preliminary trials, at the beginning of M10, just a few days before the COVID-19 lock down in Spain.	2	T3.2

CS	Ident.	Output type	Detail	Requirement Specifications	Pot. Product (Y/N/tbc)	Complete	Current TRL	WP task
	12.3.1	Product	Production of hydrolysed proteins and oil from fishery by-catch.	By 2019 the Common Fisheries Policy of the EC forces to land in ports the fishing discards. To valorise this substantial amount of waste, we propose to extract hydrolysed proteins and oil to be used as high-quality ingredients on aquaculture diets.	Y	30% A complete characterization of fish biomass side-streams has been carried out in order to clearly state the availability of raw material towards an industrial implementation at landing-ports based on enzymatic hydrolysis to obtain hydrolysed proteins and oil from them. An enzymatic process has been optimised for the hydrolysis of previously discarded fish species caught by North Atlantic fishing fleets, particularly for blue whiting. Fish protein hydrolysates obtained (at lab & pilot scale) exhibited a remarkable concentration of proteins and the profile of amino acids is interesting to be used as ingredients of fish feed diets. Thus, we have completed 30% of the activities programmed for CST12.3.	3	T3.2
	12.3.2	Product	Production of hydrolysed proteins and oil from sardine heads.	Proposes to valorise this waste form the sardine canning industry, extracting hydrolysed proteins and oil to be used as high-quality ingredients on aquaculture diets. Since sardine is relatively low trophic species (about 2), this product will be transferred to CS13.	Y	30% See above	3	T3.2
	12.3.3	Product	Production of hydrolysed proteins and oil from boiled mussel meal waste.	Proposes to valorise the undersize individuals from mussel cookers, extracting hydrolysed proteins and oil to be used as high-quality ingredients on aquaculture diets. Since mussels are relatively low trophic species (about 2), this product will be transferred to CS13.	Y	30% See above	3	T3.2
	12.4.1	Product	Data supporting the use of an aquafeed for Senegalese sole.	A new diet for Senegalese Sole juveniles based on high quality ingredients from fishery by-catch analysing key performance indicators compared with a control diet	Y	5% The task started on M9 to prepare the Road Map and to inform CST 12.3 about the amounts needed of each ingredient to formulate and produce the diets. After that, CST 12.4 has been inactive until CST 12.3 will supply the ingredients.	4	T3.2

CS	Ident.	Output type	Detail	Requirement Specifications	Pot. Product (Y/N/tbc)	Com-plete	Current TRL	WP task
13	13.2.1	Product	Diet formulation for Senegalese sole with inclusion of mussel meal.	The formulation that will include mussel meal needs to be nutritional balanced (protein, amino acids, lipid, fatty acids, vitamin and minerals) for Senegalese sole juveniles to meet the known requirements for optimal growth.	Y	21% Based on the results obtained so far, CST13.2 is at 21 %of completeness. Currently from the six products related to diet formulation for the different species, #13.2.4 for whiteleg shrimp is done. The remaining 5 products related to diet formulation are waiting for the LTS ingredients production. Therefore, from the six products related to diet performance in animal experiments, #13.2.10 related to data collected from shrimp will initiate in the coming months.	4	T3.3
	13.2.2	Product	Diet formulation for Senegalese sole with inclusion of mussel hydrolysates.	The formulation that will include mussel hydrolysates needs to be nutritional balanced (protein, amino acids, lipid, fatty acids, vitamin and minerals) for Senegalese sole juveniles to meet the known requirements for optimal growth.	Y	21% See above	4	T3.3
	13.2.3	Product	Diet formulation for Brazilian flounder with inclusion of algae.	The formulation that will include algae needs to be nutritional balanced (protein, amino acids, lipid, fatty acids, vitamin and minerals) for Brazilian flounder juveniles to meet the known requirements for optimal growth.	Y	21% See above	4	T3.3
	13.2.4	Product	Diet formulation for white leg shrimp with inclusion of algae.	The formulation that will include algae needs to be nutritional balanced (protein, amino acids, lipid, fatty acids, vitamin and minerals) for whiteleg shrimp to meet the known requirements for optimal growth.	Y	100% See above	4	T3.3
	13.2.5	Product	Diet formulation for pirarucu with inclusion of algae.	The formulation that will include algae needs to be nutritional balanced (protein, amino acids, lipid, fatty acids, vitamin and minerals) for pirarucu broodstock to promote good quality spawns.	Y	21% See above	4	T3.3
	13.2.6	Product	Diet formulation for tambaqui with inclusion of algae.	The formulation that will include algae needs to be nutritional balanced (protein, amino acids, lipid, fatty acids, vitamin and minerals) for tambaqui juveniles to meet the known requirements for optimal growth	Y	21% See above	4	T3.3

CS	Ident.	Output type	Detail	Requirement Specifications	Pot. Product (Y/N/tbc)		Complete	Current TRL	WP task
	13.2.7	Product	Diet for Senegalese sole with inclusion of mussel meal.	The diet will have a pellet quality (e.g. density, durability, hardness, water stability), size, and shape suitable for the species and stage.	Y	See above	21%	4	T3.3
	13.2.10	Product	Diet for white leg shrimp with inclusion of algae.	The diet will have a pellet quality (e.g. density, durability, hardness, water stability), size, and shape suitable for the species and stage.	Y	See above	21%	4	T3.3
	13.2.11	Product	Diet for pirarucu with inclusion of algae.	The diet will have a pellet quality (e.g. density, durability, hardness, water stability), size, and shape suitable for the species and stage.	Y	See above	21%	4	T3.3
	13.2.12	Product	Diet for tambaqui with inclusion of algae.	The diet will have a pellet quality (e.g. density, durability, hardness, water stability), size, and shape suitable for the species and stage.	Y	See above	21%	4	T3.3

The exploitation potential of AV is high. Out of the 43 outputs, two are categorized as reports and 41 as products. The reports will feature the analysis of product quality, sustainability and nutritional value for the newly developed species. The products range from low and high trophic species, protein hydrolysates, new feed formulations incorporating LTS, diets for high trophic species, paints, software solutions, foodstuff to new production and harvesting technologies. With the exception of the two reports and the "*holding facilities for sea cucumber IMTA with Abalone*", all outputs have a clear potential for becoming future sellable products. For the reports and the facility, the developments within the second 24-month loop will confirm their potential. It is expected that the number of sellable products will increase further as AV progresses over time. A look at D1.2 and D2.2 reveals that an additional 28 outputs are marked as to be confirmed to be marketable by the end of the project. Three of these are reports and 25 are processes for the cultivation of various species. If developments within the coming years are successful, the numbers of sellable outputs will grow accordingly.

Sugar kelp (*Saccharina latissima*) is already a product that is available on the market with a TRL of 9 (although the production systems in AquaVitae are unique). In three cases the completeness of the prototype products is above 80%, the remaining products have not yet reached a completeness of above 40%, with the majority being at or below 20%. For detailed information on the percentage completeness of any specific output please see annex 3 of D1.2 (the first two numbers of the identifier – see table 1 will lead you to the respective CS task). Besides the produced sugar kelp, the TRL is ranging from 2-5. This is a good interim result after the first quarter of the project is over. According to expectations and the CS reports work is right on time.

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3. Conclusion

Work Packages 1, 2 and 3 have developed a common system to increase reporting efficiency for CS leaders (from 35 institutions across four continents) that produce outcomes that contribute to more than one of these research and innovation work packages. This reporting system was also designed to make the large volume of research (13 case studies, each with numerous tasks) easily available to the project team.

AquaVitae is all about generating impact in society. Impact means that the main project outputs will be accepted and used, by project industry partners and stakeholders from outside of the consortium, and this will continue after the project has finished. This is guaranteed by AquaVitae's multi-actor approach. It will make demand-driven innovation through the involvement of various stakeholders all along the project. D3.2 plays a role in this approach as it is the first time that we have fully identified the exploitation potential by summarizing all 43 post-harvest products that will be developed by the 13 CS.

This report will be used to demonstrate this potential to/with possible external users. Through WP9's stakeholder workshops and another round of stakeholder interviews, AV will extract stakeholder opinions about these products. This will likely result in updated requirements for the next versions to be developed during the second 24-month development loop.

In accordance with the DoA, WP3 will use D3.2 and the resulting feedback to choose the first out of four products to be tested with IRG members or external stakeholders, between M12-24. Further product tests will follow between M24-36 (1x) and M36-48 (2x). In addition, the work on product characteristics, consumer attitudes and market potential (WP5), sustainability, circular economy, environmental monitoring and risk assessment (WP6), and value chain analysis, profitability and socio-economic aspects (WP7) directly relates to the major outputs summarized within this deliverable. Finally, it will be used by WP5-7 participants, who can begin to kick-off their work in analysing the specific aspects of the different post-harvest products.