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# D3.7 Optimized technical datasheets for produced fertilisers and biostimulants

**Project Acronym: SEA2LAND**

**Project full name: Producing advanced bio-based fertilizers from fisheries wastes**

**Grant Agreement No. 101000402**

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# Document Summary

**Deliverable Title: D3.7** Optimized technical datasheets for produced fertilisers and biostimulants.

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| Version | PUBLICATION DATE | CHANGES |
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| 0.4 Final draft | 02/05/2025 | FINAL DRAFT |
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| 0.6 First revision corrected final draft | 16/06/2025 | CORRECTIONS AND SUGGESTIONS IMPLEMENTED |

**Deliverable Lead:** Fertinagro Biotech (FTN)

**Related Work package:** WP3 – Recovering nutrients from fishery and fish processing industry by products

**Author(s):** Joaquin Romero (FTN), Carlos Fuertes (FTN)

**Contributor(s):** Carlos Bald (AZTI), Bruno Iñarra (AZTI), Mónica Gutierrez (AZTI), Haizea Domínguez (AZTI), Iratxe Urreta (NEIKER), Sonia Suárez (NEIKER), Miriam Pinto (NEIKER), Iñaki Aramburu (BARNA), Marie Soone (NUTRILOOP), Salman Nisar (UNIVPM), Marta Dell' Orto (UNIMI), Carla Maggetti (UNIVPM)

**Reviewer(s):** Miriam Pinto (project coordinator, NEIKER), Bruno Iñarra (WP3 leader, AZTI)

**Dissemination level:**

☒ PU, Public

☐ PP, restricted to other programme participants (including the Commission Services)

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**APPROVED BY:** Miriam Pinto (project coordinator, NEIKER), Carlos Bald (WP3 leader, AZTI) (before submission to the EU).

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# Abstract

Within SEA2LAND project, and more specifically in WP3, side-streams from fishery and fish and shellfish processing by-products or side-streams were used as raw materials to produce intermediate products suitable for being formulated into biobased fertilisers (BBF). The present document includes the final version of the technical data sheets of finally selected intermediate ingredients and validates BBFs produced from and fish and shellfish processing by-products or side-streams in three different regions, the Baltic Sea, the Cantabrian Sea and the Adriatic Sea.

# Disclaimer:



# Glossary

**BBF:** biobased fertiliser

**IP**: intermediate product

**MW**: molecular weight

# 1 Produced fertilisers and biostimulants

During the SEA2LAND project, various intermediate products (IP) and biobased fertilisers (BBF) have been obtained through the valorisation of by-products from the fishery and fish processing industries. The following table presents all the IPs and BBFs generated within the project. These products are then described in detail in the subsequent sections of this document. It should be noted that in cases where the composition of the BBF is identical to that of the IP from which it is derived, the product has only been detailed under the BBF category.

| Pilot Region | IP | BBF Proposed | BBF prototypes Obtained |
|---|---|---|---|
| Cantabrian | **IP1.** Viscera protein enzymatic hydrolysate | Foliar fertiliser | **FER1.** Solid biostimulant N, AA, organic matter and humic extract.<br>**FER2.** Liquid biostimulant N and AA. |
| | ***IP2.** Cooking waters protein enzymatic hydrolysate | Plant biostimulant | |
| | **IP3.** Viscera protein autolysate | Plant biostimulant<br>Foliar fertiliser | **FER3.** NPK solution with aminoacids<br>**FER4.** Liquid biostimulant N, AA, organic matter and humic extract. |
| | **IP4.** Microalgae biomass | Plant biostimulant | **FER5** Fertilizer with humic acids. |
| Adriatic | **IP5.** Protein hydrolysate | Plant biostimulant | **UNI1.** Liquid biostimulant |
| | **IP6.** Biochar | Soil improver/growth media | **UNI5.** Organic soil amendment or Soil improver |
| | **IP7.** Biochar-compost composite | Soil improver/growth media | **UNI2.** Soil improver |
| | **IP8.** Mineral fraction | Liming agent | **UNI4.** Liming agent |
| | ****IP9.** Chitin/chitosan | N-fertiliser | **UNI3.** Liquid organic fertilizer |
| Baltic | **IP10.** Bokashi pellet | Organic fertiliser | **BP.** Organic fertilizer bokashi pellet |
| | **IP11.** Bokashi ferment. Liquid. | Foliar fertiliser | **FS.** Biostimulant with amino and humic acids |
| | **IP12.** Vermicompost | Soil improver/growth media | **VER.** Organic soil improver/ growth media |
| | **IP13.** Fermented fish and other food wastes | Organic fertilizer, foliar fertilizer, soil improver | **BP., FS., VER.** |

* no data sheet reported due to unsuccessful results.
** No data sheet reported due to the process's chemical demand and cost-intensive nature. Thus, it was not optimised at pilot scale.

# 2 IP1 - Concentrated hydrolysate obtained from enzymatic hydrolysis of rainbow trout viscera

## 2.1 Product description

Concentrated hydrolysate obtained from enzymatic hydrolysis of rainbow trout viscera. Brown colour and molasse texture.

## 2.2 Applications

Intermediate product for the formulation of foliar bio-based fertilisers.

## 2.3 Product composition

### 2.3.1 General composition and metals

| Composition | Units | Result |
|---|---|---|
| pH | - | 6.39 |
| Conductivity | mS/cm | 3.72 |
| Dry matter | % | 52.5 ± 0.5 |
| Total nitrogen | % | 5 |
| Ammonia N | % | 1 |
| Free amino acids | % | 19.5 ± 0.02 |
| Protein | % | 31.4 ± 0.04 |
| Ash | % | 4.1 ± 0.03 |
| $K_2O$ | % | 0.85 |
| Na | % | 1.45 |
| $P_2O_5$ | % | 1.39 |
| $SO_3$ | % | 1.91 |
| Cd | mg/kg DM | 0.51 |
| Ni | mg/kg DM | 7.70 |
| Cu | mg/kg DM | 110.91 |
| Cr | mg/kg DM | 7.87 |
| Zn | mg/kg DM | 610.23 |
| Hg | mg/kg DM | 0.74 |
| Pb | mg/kg DM | n.d. |

### 2.3.2 Amino acid profile

| Amino acid profile | Unit | Free AA |
|---|---|---|
| Thr | % | n.d. |
| Cys | % | 0.01 ± 0.0003 |
| Tyr | % | 1.7 ± 0.03 |
| Val | % | 1.8 ± 0.02 |
| Met | % | 0.9 ± 0.01 |
| Lys | % | 1.7 ± 0.2 |
| Ile | % | 1.4 ± 0.02 |
| Leu | % | 2.2 ± 0.02 |
| Phe | % | 1.2 ± 0.009 |
| Arg | % | 0.6 ± 0.009 |
| Ala | % | 1.9 ± 0.02 |
| Asp | % | 0.7 ± 0.001 |
| Ser | % | 0.02 ± 0.006 |
| Glu | % | 2.3 ± 0.02 |
| Gly | % | 1.1 ± 0.004 |
| Asn | % | 0.5 ± 0.007 |
| His | % | 0.6 ± 0.01 |

### 2.3.3 Molecular size profile

| MW range (Da) | % |
|---|---|
| 50000-27000 | 0.0 |
| 27000-10000 | 0.1 |
| 10000-6500 | 0.2 |
| 6500-3000 | 1.3 |
| 3000-2000 | 1.4 |
| 2000-1000 | 5.0 |
| 1000-500 | 21.2 |
| 500-300 | 6.6 |
| 300-100 | 22.9 |
| 100-1 | 40.1 |

### 2.3.4 Microbiology

| Species | Concentration |
|---|---|
| Salmonella | Not detected |
| Faecal coliforms | <10 UFC/g |
| E. coli | <10 UFC/g |

## 2.4 References

### 2.4.1 Analytical methods

The proximate composition of the samples was analysed according to the Association of Official Analytical Chemists (AOAC) Official Methods (2007):

Protein content: Kjeldahl nitrogen x 5.7 for fish (method 955.04).

Ammoniacal N: Kjeldahl method based on UNE-EN 15475

Ash: calcination in furnace overnight at 550 ºC (method 942.05).

Dry matter: drying samples at 105 ºC until constant weight (method 934.01).

Amino acids were determined by hydrolysis with HCl 6 N 110 ºC 24 h, neutralization with NaOH 6 N derivatization separation on a reverse-phase column Poroshell HPH-C18, 4.6 x 100 mm, 2.7 µm in a HPLC 1100 series (Agilent Technologies, USA) with a Diode Array Detector (DAD) at excitation and emission wavelengths of 338 and 390 nm for primary and 262 and 324 nm for secondary amino acids, respectively. Free amino acids are determined previous extraction with HCl 0.6 N.

Hg, Pb, As, Cd, Ni, Cu, Cr and Zn: graphite furnace atomic absorption spectroscopy (GFAAS) previous calcination and acid extraction (AOAC, 999.11).

K: flame Atomic Absorption Spectrometry previous calcination in furnace (AOAC, 969.23).

Total P: spectrophotometric method with molybdovanadate reagent previous calcination (CE 152/2009).

Total S: Determined by ICP-OES after acidic digestion.

Conductivity: conductivity meter after water extraction (ratio 1/5 w/w) (EN 13038, 2011).

Molecular size profile: *Size exclusion high performance liquid chromatography (SEC-HPLC)*.

Salmonella spp: real time PCR with iQ-Check™ Salmonella II kit from BIO-RAD and iQ-Check™ Enterobacteriaceae Count Plate (AFNOR 3M 01/06-09/97) and Escherichia coli in 3MTM PETRIFILMTM Select E. coli Count Plate (SEC) (AFNOR 3M 01/08-06/01).

### 2.4.2 Applicable legislation

Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 and repealing Regulation (EC) No 2003/2003. This regulation establishes harmonised requirements for EU fertilising products, including definitions, quality and safety criteria, labelling, and conformity assessment procedures.

Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption, and Commission Regulation (EU) No 142/2011 of 25 February 2011 implementing it. These regulations define categories of animal by-products (ABPs), processing standards, end points for safe use, and permitted applications in fertilising products, including requirements for traceability, treatment, and use restrictions.

Royal Decree RD 506/2013, of 28 June, on fertilizer products. Spanish Ministry of Presidency. This decree governs the national framework for the production, marketing, and use of fertilising materials in Spain that are not CE-marked, including classification, labelling, and authorised product types.

### 2.4.3 Product proprietary

AZTI Fundazioa/AZTI Foundation

Bizkaiko Zientzia eta Teknologia Parkea, Astondo bidea E609, 48160 Derio (Bizkaia) Spain

Contact: Carlos Bald (cbald@azti.es)

# 3 IP3 - Concentrated hydrolysate obtained from silage of rainbow trout viscera

## 3.1 Product description

Concentrated hydrolysate obtained from acid autolysis of rainbow trout viscera. Brown colour and molasse texture.

## 3.2 Applications

Intermediate product for the formulation of foliar bio-based fertilisers.

## 3.3 Product composition

### 3.3.1 General composition and metals

| Composition | Units | Result |
|---|---|---|
| pH | - | 4.69 |
| Conductivity | mS/cm | 28.7 |
| Dry matter | % | 36.3 ± 0.5 |
| Total nitrogen | % | 4.3 |
| Ammonia N | % | 0.54 |
| Free amino acids | % | 12.5 ± 0.2 |
| Protein | % | 26.5 ± 0.03 |
| Ash | % | 2.1 ± 0.1 |
| $P_2O_5$ | % | 0.98 |
| $K_2O$ | % | 0.9 |
| Na | % | 0.44 |
| $SO_3$ | % | 1.37 |
| Ni | mg/kg DM | 62.64 |
| Pb | mg/kg DM | 12.09 |
| Cu | mg/kg DM | 101.13 |
| Cr | mg/kg DM | 87.19 |
| Zn | mg/kg DM | 644.08 |
| Hg | mg/kg DM | n.d |
| Cd | mg/kg DM | n.d |

### 3.3.2 Amino acid profile

| Amino acid profile | Unit | Free AA |
|---|---|---|
| Thr | % | 0.81 ± 0.005 |
| Cys | % | 0.1 ± 0.002 |
| Tyr | % | 0.2 ± 0.001 |
| Val | % | 0.9 ± 0.0 2 |
| Met | % | 0.5 ± 0.008 |
| Lys | % | 0.7 ± 0.04 |
| Ile | % | 0.8 ± 0.02 |
| Leu | % | 1.7 ± 0.04 |
| Phe | % | 0.6 ± 0.01 |
| Arg | % | 0.4 ± 0.02 |
| Ala | % | 0.6 ± 0.01 |
| Asp | % | 0.5 ± 0.008 |
| Ser | % | 0.8 ± 0.009 |
| Glu | % | 0.9 ± 0.01 |
| Gly | % | 0.8 ± 0.02 |
| Pro | % | 0.4 ± 0.02 |
| His | % | 0.34 ± 0.004 |

### 3.3.3 Microbiology

| Species | Concentration |
|---|---|
| Salmonella | Not detected |
| Faecal coli | <10 UFC/g |
| E. coli | <10 UFC/g |

## 3.4 References

### 3.4.1 Analytical methods

The proximate composition of the samples was analysed according to the Association of Official Analytical Chemists (AOAC) Official Methods (2007).

Protein content: Kjeldahl nitrogen x 5.7 for fish (method 955.04).

Ammoniacal N: Kjeldahl method based on UNE-EN 15475

Ash: calcination in furnace overnight at 550 ºC (method 942.05).

Dry matter: drying samples at 105 ºC until constant weight (method 934.01).

Amino acids were determined by hydrolysis with HCl 6 N 110 ºC 24 h, neutralization with NaOH 6 N derivatization separation on a reverse-phase column Poroshell HPH-C18, 4.6 x 100 mm, 2.7 µm in a HPLC 1100 series (Agilent Technologies, USA) with a Diode Array Detector (DAD) at excitation and emission wavelengths of 338 and 390 nm for primary and 262 and 324 nm for secondary amino acids, respectively. Free amino acids are determined previous extraction with HCl 0.6 N.

Hg, Pb, As, Cd, Ni, Cu, Cr and Zn: graphite furnace atomic absorption spectroscopy (GFAAS) previous calcination and acid extraction (AOAC, 999.11).

K: flame Atomic Absorption Spectrometry previous calcination in furnace (AOAC, 969.23).

Total P: spectrophotometric method with molybdovanadate reagent previous calcination (CE 152/2009).

Total S: Determined by ICP-OES after acidic digestion.

Conductivity: conductivity meter after water extraction (ratio 1/5 w/w) (EN 13038, 2011)

Molecular size profile: *Size exclusion high performance liquid chromatography (SEC-HPLC)*.

Salmonella spp: real time PCR with iQ-Check™ Salmonella II kit from BIO-RAD and iQ-Check™ Enterobacteriaceae Count Plate (AFNOR 3M 01/06-09/97) and Escherichia coli in 3MTM PETRIFILMTM Select E. coli Count Plate (SEC) (AFNOR 3M 01/08-06/01).

### 3.4.2 Applicable legislation

Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 and repealing Regulation (EC) No 2003/2003. This regulation establishes harmonised requirements for EU fertilising products, including definitions, quality and safety criteria, labelling, and conformity assessment procedures.

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### 3.4.3 Product proprietary

AZTI Fundazioa/AZTI Foundation
Bizkaiko Zientzia eta Teknologia Parkea, Astondo bidea E609, 48160 Derio (Bizkaia) Spain
Contact: Carlos Bald (cbald@azti.es)

# 4 IP4 - Microalgae biomass

## 4.1 Product description

Dry biomass from a microalga cultivated with brines from cooking wastewaters. Orange colour and flour texture.

## 4.2 Applications

Intermediate product that was subjected to enzymatic protein hydrolysis for the formulation of a NPK solution supplemented with the microalga-derived hydrolysate.

## 4.3 Product composition

### 4.3.1 General composition and metals

| Composition | Units | Result |
|---|---|---|
| Total carbon | % | 45.2 |
| Total nitrogen | % | 7.03 |
| Al | g/kg | <0.03 |
| As | mg/kg | <2.5 |
| Ca | g/kg | 3.13 |
| Co | mg/kg | <1 |
| Cr | mg/kg | <1 |
| Cu | mg/kg | 3.31 |
| Fe | mg/kg | <150 |
| K | g/kg | 12.17 |
| Mg | g/kg | 1.12 |
| Mn | mg/kg | 72.68 |
| Mo | mg/kg | <2 |
| Na | g/kg | 19.47 |
| Ni | mg/kg | <1 |
| P | g/kg | 10.3 |
| Pb | mg/kg | <2 |
| S | g/kg | 21 |
| Zn | mg/kg | 119.86 |

### 4.3.2 Microbiology

| Species | Concentration |
|---|---|
| Salmonella | Not detected |
| Total coliforms | <3 MPN/g |
| E. coli | <3 MPN/g |

## 4.4 References

### 4.4.1 Analytical methods

Total carbon (**C**) was determined by electrothermic combustion and NDIR detection using an elemental analyser CN828 (LECO Instrument).

Total nitrogen (**N**) was determined by electrothermic combustion and TC detection using elemental analyser CN828 (LECO Instrument).

Mineral composition was analysed in 0.15 g of dry sample after microwave (Multiwave 5000, Anton Paar) digestion with nitric acid (16 %) using spectrophotometry (5800 ICP-OES, Agilent). Quantification was made using standard curves of each mineral (standards from Agilent technologies).

Microbiological analysis was carried out with the most probable number (MPN) method according to standards ISO 6579-1 (2017), UNE-EN-ISO6887-1 (2017) and UNE-EN-ISO 6887-4 (2017).

### 4.4.2 Applicable legislation

Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 and repealing Regulation (EC) No 2003/2003. This regulation establishes harmonised requirements for EU fertilising products, including definitions, quality and safety criteria, labelling, and conformity assessment procedures.

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### 4.4.3 Product proprietary

NEIKER-BRTA
Parque Tecnológico de Bizkaia, Parcela 812. Berreaga 1. 48160. Derio (BIZKAIA)
Contact: Miriam Pinto (mpinto@neiker.eus)

# 5 IP13 - Fermented fish and other food wastes

## 5.1 Product description

IP Ferment is produced through bokashi fermentation of salmon scraps (mainly heads, bones, collars, cheeks, spines and bellies) and other food waste from HORECA. Product includes beneficial microorganisms (mainly lactic acid microbes). The ferment will be further used for the further production of granules and vermicompost.

## 5.2 Applications

IP will be used in the production of biogranule and vermicompost BBFs.

## 5.3 Product composition

### 5.3.1 General composition and metals

| Composition | Units | Result |
|---|---|---|
| Dry matter content | % | 25±10 |
| Ash content | % | 0.9 |
| Density | kg/m3 | 1104 |
| Organic matter content | % | 14.3 |
| Conductivity | mS/cm | 2.0 |
| Total nitrogen | % | 0.2 |
| Total $P_2O_5$ | % | 0.738 |
| Ca | mg/100 g | 68.9 |
| Mg | mg/100 g | 19.4 |
| Na | mg/100 g | 54.3 |
| Cl | mg/100 g | 68.8 |
| $SO_4^{2-}$ | mg/100 g | 49.6 |
| $K_2O$ | mg/100 g | 0.197 |

### 5.3.2 Amino, humic and fulvic acid profile

**Content of humic and fulvic acids**

| | | |
|---|---|---|
| Humic acid | % | 2.445 |
| Total Humic Extract | % | 12.370 |
| Fulvic acid | % | 9.926 |

## Content of free amino acids

| Free AA | Unit | Result |
|---|---|---|
| Alanine | % | 0.096 |
| Glutamic acid | % | 0.012 |
| Glycine | % | 0.033 |
| Isoleucine | % | 0.027 |
| Leucine | % | 0.046 |
| Methionine | % | 0.006 |
| Ornithine | % | 0.003 |
| Phenylalanine | % | 0.022 |
| Proline | % | 0.009 |
| Taurine | % | 0.033 |
| Threonine | % | 0.003 |
| Valine | % | 0.046 |
| **Total** | **%** | **0.336** |

### 5.3.3 Microbiology

| Species | Concentration |
|---|---|
| Salmonella | n. d. |
| Faecal coliforms | <10 |
| E. coli | 90 |

## Beneficial microbial community

| Taxonomic level | Taxonomic unit | Normalized fraction |
|---|---|---|
| s | *Lactiplantibacillus plantarum* | 0.486964 |
| s | *Leuconostoc gelidum* | 0.383731 |
| g | *Leuconostoc spp* | 0.029148 |
| g | *Latilactobacillus spp* | 0.028415 |
| g | *Lactiplantibacillus spp* | 0.017918 |
| g | *Companilactobacillus spp* | 0.014288 |
| s | *Leuconostoc mesenteroides* | 0.011445 |
| g | *Levilactobacillus spp* | 0.005257 |
| s | *Paucilactobacillus oligofermentans* | 0.004363 |
| | ***Lactic acid bacteria*** | **0.9815** |

## 5.4 References

### 5.4.1 Analytical methods

Dry matter content %: ISO 18134-2:2017. Ash content %: ISO 18122:2015. Density kg/m3: ISO 17828:2015. Organic matter content %: Calculatory. EC mS/cm: TC WI:2003 (E). TN %: Kjeldahl method. TP mg/100 g: EVS-ISO 2294:2000. Ca, Mg, Na, K (mg/100 g): T208. Mg mg/100 g: T208. Cl, $SO_4^{2-}$ (mg/100 g): T206.

Analytical Methods of fulvic, humic and amino acids: Dry matter was determined by C5110015 Gravimetry, Gravimetry (XK 563/LE1047 Eurofins Agroambiental (Sidamon) UNE-EN ISO/IEC 17025:2017 ENAC nº 563/LE1047). The percentage of total humic extract, humic acid and fulvic acid were determined using Internal Method titulometry, Titrimetry (XK Eurofins Agroambiental (Sidamon) (Not accredited)). Free amino acids were determined using ISO 13903:2005 method (DJ 581 Eurofins Vitamin Testing Denmark DS EN ISO/IEC 17025 DANAK 581)

Analysis of the microbial community of the product was performed in the Center of Food and Fermentation Technologies (Tallinn, Estonia). The most abundant identified taxonomic units in the sample. Represented data are normalised to 1. *DNA extraction and library preparation* 5-10 g of sample was taken for analysis. Sterile isotonic saline was added and serial washing and centrifugation steps were performed to collect the cells. To detect alive bacteria only, cells were treated by 25 nM PMAxx reagent (Biotinum) according to the manufacturer's instruction. After the material preliminary preparation gDNA was extracted using ZymoBIOMICS Quick-DNA Fungal/Bacterial Miniprep Kit (Lot: 2975601). Concentration of DNA samples was measured using Qubit ™ 3.0 fluorometer (Thermo Scientific). Library was prepared according to the in-house sequencing protocol, with V4 (F515/R806) primer pair for 16S sequencing (Caporaso et al, PNAS 2011). *Sequencing:* Sequencing was performed using iSeq (SN FS10000643, Illumina) and iSeq 100 i1 Reagent Kit v2 by 2x150 bp and dual index setup. *16 S rRNA Read Statistics.* Sequencing run passed the quality control criteria with 79.38 % PF reads identified and the total Q30 score 90.33 %.

Sequencing Output: Intensity: 110; Clusters PF %: 79.38+/-5.27; Error rate %: 0.55 +/- 0.10; Yield: 0.15 Gbp; *Microbiome Analysis Pipeline*. The processing of sequencing reads according to the primer sequences has been performed with in-house scripts. 16S rRNA sequence data were analysed using BION-meta (http://www.box.com/bion\h), according to the author's instructions. Consensus reads were aligned to the SILVA

reference 16S rDNA database (v138). The bacterial designation was analysed at different taxonomic levels down to species if applicable.

### 5.4.2 Applicable legislation

Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products, amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 and repealing Regulation (EC) No 2003/2003. This regulation establishes harmonised requirements for EU fertilising products, including definitions, quality and safety criteria, labelling, and conformity assessment procedures.

Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption, and Commission Regulation (EU) No 142/2011 of 25 February 2011 implementing it. These regulations define categories of animal by-products (ABPs), processing standards, end points for safe use, and permitted applications in fertilising products, including requirements for traceability, treatment, and use restrictions.

Estonian Ministry of Environment Regulation on compost producing from biowaste (08/04/2013 - *Biolagunevatest jäätmetest komposti tootmise* nõuded).

### 5.4.3 Product proprietary

OÜ Nutriloop

Tööstuse tn 47a-89, Tallinn, 10416 Estonia

Contact: Marie Soone (marie@nutriloop.org)

# 6 FER1 - Solid biostimulant

## 6.1 Product description

Water-soluble powder biostimulant with free amino acids, organic matter and humic extract.

## 6.2 Applications

FER1 is designed to improve plant nutrition, stimulate biological activity in soil, and enhance crop growth boosting both soil and plant health. It acts as a biostimulant and soil conditioner, enhancing nutrient uptake, promoting root growth, and improving soil structure and microbial activity. Its high organic matter content enhances soil fertility and water retention capacity. The high amino acid content increase protein synthesis and stress tolerance. The humic extract improves nutrient availability and cation exchange capacity. Additionally, it aids in crop recovery from environmental stresses and improves root establishment during transplanting.

Suitable for a wide range of crops, including horticultural crops, fruit trees, cereals, and vineyards ensuring flexible and efficient nutrient and biostimulant delivery. Recommended for application via fertigation, foliar spray, and hydroponic systems.

FER1 supports circular economy practices and can potentially be used in organic farming.

## 6.3 Product composition

### 6.3.1 General composition and metals

| Composition | Units | Result |
|---|---|---|
| Dry matter | % | 95.68 |
| Total nitrogen | % | 6.30 |
| Ammonia N | % | 2.36 |
| Free amino acids | % | 16.12 |
| Organic matter | % | 91.79 |
| Humic extract | % | 43.35 |
| Humic acids | % | 2.19 |
| Fulvic acids | % | 41.16 |
| Na | % | 0.80 |
| CaO | % | 0.36 |

| | | |
|---|---|---|
| $P_2O_5$ | % | 0.12 |
| $K_2O$ | % | 0.58 |
| $SO_3$ | % | 0.69 |
| $SO_4$ | % | 0.86 |
| MgO | % | 0.15 |
| Furfural | ppm | 0.03 |
| Conductivity | mS/cm | 16.33 |
| pH | - | 3.81 |
| Cd | mg/kg DM | <1.5 |
| Cr VI | mg/kg DM | <2 |
| Pb | mg/kg DM | <120 |
| Hg | mg/kg DM | <1 |
| Ni | mg/kg DM | <50 |
| As | mg/kg DM | <40 |
| Cu | mg/kg DM | <600 |
| Zn | mg/kg DM | <1500 |

### 6.3.2 Microbiology

| Species | Concentration |
|---|---|
| Salmonella | Not detected |
| Faecal coliforms | <10 UFC/g |
| E. coli | <10 UFC/g |

## 6.4 References

### 6.4.1 Applicable legislation

Regulation (EU) 2019/1009 of the European Parliament and of the Council, which lays down rules on the making available on the market of EU fertilizing products. It is likely classified under Product Function Category (PFC) 6 – Plant biostimulant given its composition and intended use. As it contains ingredients derived from fishery by-products, it must comply with Regulation (EC) No 1069/2009 (laying down health rules as regards animal by-products and derived products not intended for human consumption) and its implementing Regulation (EU) 142/2011.

For use in organic farming, compliance with Regulation (EU) 2018/848 of the European Parliament and of the Council on organic production and labelling of organic products is required, ensuring that inputs meet organic farming criteria and repealing Council Regulation (EC) No 834/2007. Additionally, products should be authorised in Annex II of the implementing regulation (EU) 2021/1165 authorising certain products and substances for use in organic production.

At national level, Royal Decree RD 506/2013, of 28 June, which establishes rules for the production, marketing and use of fertilizing products that are not CE marked as well as RD 999/2017, which regulates the use of animal by-products and derived products as fertilizer or soil amendments.

### 6.4.2 Product proprietary

Fertinagro Biotech

Polígono Industrial Los Llanos s/n. 44760, Utrillas (Teruel)

Contact: Joaquin Romero (joaquin.romero@tervalis.com), Carlos Fuertes (fuertes.carlos@tervalis.com).

# 7 FER2 - Liquid biostimulant

## 7.1 Product description

Liquid water-soluble biostimulant with free amino acids.

## 7.2 Applications

FER2 is designed to stimulate plant growth and improve crop performance throughout different developmental stages. It acts as a biostimulant by enhancing root development, increasing nutrient absorption efficiency, and improving plant tolerance to abiotic stresses such as drought, heat, salinity, and transplant shock. Its high content of free amino acids enhances protein synthesis, metabolic activity, and chlorophyll production, promoting vigorous vegetative growth and flowering. The balanced presence of nitrogen, phosphorus, potassium, and organic matter supports nutrient uptake and improves soil fertility. The product also aids in faster recovery of crops affected by adverse conditions or intensive agricultural practices.

Suitable for a wide range of crops, including horticultural crops, fruit trees, cereals, and vineyards where boosting metabolism and stress tolerance are key to optimizing yield and quality. Recommended for application via foliar spray or fertigation to maximize nutrient delivery and stimulate plant vitality.

FER2 supports circular economy strategies and can potentially be used in organic farming.

## 7.3 Product composition

### 7.3.1 General composition and metals

| Composition | Units | Result |
|---|---|---|
| Dry matter | % | 41.00 |
| Total nitrogen | % | 4.00 |
| Free amino acids | % | 19.50 |
| Organic matter | % | 40.00 |
| $P_2O_5$ | % | 1.00 |
| $K_2O$ | % | 0.90 |
| $SO_3$ | % | 0.10 |
| $SO_4$ | % | 0.15 |
| pH | - | 5.90 |
| Cd | mg/kg DM | <1.5 |

| | | |
|---|---|---|
| Cr VI | mg/kg DM | <2 |
| Pb | mg/kg DM | <120 |
| Hg | mg/kg DM | <1 |
| Ni | mg/kg DM | <50 |
| As | mg/kg DM | <40 |
| Cu | mg/kg DM | <600 |
| Zn | mg/kg DM | <1500 |

### 7.3.2 Microbiology

| Species | Concentration |
|---|---|
| Salmonella | Not detected |
| Faecal coliforms | <10 UFC/g |
| E. coli | <10 UFC/g |

## 7.4 References

### 7.4.1 Applicable legislation

Regulation (EU) 2019/1009 of the European Parliament and of the Council, which lays down rules on the making available on the market of EU fertilizing products. It is likely classified under Product Function Category (PFC) 6 – Plant biostimulant, given its composition and intended use. As it contains ingredients derived from fishery by-products, it must comply with Regulation (EC) No 1069/2009 (laying down health rules as regards animal by-products and derived products not intended for human consumption) and its implementing Regulation (EU) 142/2011.

For use in organic farming, compliance with Regulation (EU) 2018/848 of the European Parliament and of the Council on organic production and labelling of organic products is required, ensuring that inputs meet organic farming criteria and repealing Council Regulation (EC) No 834/2007. Additionally, products should be authorised in Annex II of the implementing regulation (EU) 2021/1165 authorising certain products and substances for use in organic production.

At national level, Royal Decree RD 506/2013, of 28 June, which establishes rules for the production, marketing and use of fertilizing products that are not CE marked as well as RD 999/2017, which regulates the use of animal by-products and derived products as fertilizer or soil amendments.

### 7.4.2 Product proprietary

Fertinagro Biotech

Polígono Industrial Los Llanos s/n. 44760, Utrillas (Teruel)

Contact: Joaquin Romero (joaquin.romero@tervalis.com), Carlos Fuertes (fuertes.carlos@tervalis.com).

# 8 FER3 - NPK solution with aminoacids

## 8.1 Product description

Liquid water-soluble NPK solution with free aminoacids.

## 8.2 Applications

FER3 is designed to provide a balanced supply of essential macronutrients together with bioactive compounds that stimulate plant growth, improve nutrient uptake and enhance overall crop performance. It acts as both a nutrient source and a biostimulant, delivering nitrogen, phosphorus and potassium for immediate plant needs, while the amino acids and organic matter boost metabolic activity, promote root development and improve soil fertility. Its content of free amino acids can enhance protein synthesis and chlorophyll production, stimulating vegetative growth and overall plant vigour. The presence of organic matter improves nutrient availability, soil microbial activity, and water retention. The macronutrients N, P and K directly support root development, flowering, and fruiting, ensuring balanced nutrition throughout the crop cycle.

Suitable for a wide range of crops, including horticultural crops, fruit trees, cereals, and vineyards where balanced nutrient supply and stimulation of plant vitality are key to maximizing yield and quality. Recommended for application via foliar spray or fertigation systems, allowing efficient nutrient and biostimulant delivery throughout different growth stages.

FER3 supports circular economy principles.

## 8.3 Product composition

### 8.3.1 General composition and metals

| Composition | Units | Result |
|---|---|---|
| Dry matter | % | 45.00 |
| Total nitrogen | % | 5.00 |
| Free amino acids | % | 7.50 |
| Organic matter | % | 38.50 |
| CaO | % | 0.20 |
| $P_2O_5$ | % | 3.00 |
| $K_2O$ | % | 3.00 |
| $SO_3$ | % | 1.50 |
| pH | - | 4.90 |

| | | |
|---|---|---|
| Cd | mg/kg DM | <1.5 |
| Cr VI | mg/kg DM | <2 |
| Pb | mg/kg DM | <120 |
| Hg | mg/kg DM | <1 |
| Ni | mg/kg DM | <50 |
| As | mg/kg DM | <40 |
| Cu | mg/kg DM | <600 |
| Zn | mg/kg DM | <1500 |
| Biuret | ppm | <12 |

### 8.3.2 Microbiology

| Species | Concentration |
|---|---|
| Salmonella | Not detected |
| Faecal coliforms | <10 UFC/g |
| E. coli | <10 UFC/g |

## 8.4 References

### 8.4.1 Applicable legislation

Regulation (EU) 2019/1009 of the European Parliament and of the Council, which lays down rules on the making available on the market of EU fertilizing products. It is likely classified under Product Function Category (PFC) 1 – Fertilizer (organo-mineral fertilizer) and/or PFC6 - Plant biostimulant. As it contains ingredients derived from fishery by-products, it must comply with Regulation (EC) No 1069/2009 (laying down health rules as regards animal by-products and derived products not intended for human consumption) and its implementing Regulation (EU) 142/2011.

For use in organic farming, compliance with Regulation (EU) 2018/848 of the European Parliament and of the Council on organic production and labelling of organic products is required, ensuring that inputs meet organic farming criteria and repealing Council Regulation (EC) No 834/2007. Additionally, products should be authorised in Annex II of the implementing regulation (EU) 2021/1165 authorising certain products and substances for use in organic production.

At national level, Royal Decree RD 506/2013, of 28 June, which establishes rules for the production, marketing and use of fertilizing products that are not CE marked as well as

RD 999/2017, which regulates the use of animal by-products and derived products as fertilizer or soil amendments.

### 8.4.2 Product proprietary

Fertinagro Biotech

Polígono Industrial Los Llanos s/n. 44760, Utrillas (Teruel)

Contact: Joaquin Romero (joaquin.romero@tervalis.com), Carlos Fuertes (fuertes.carlos@tervalis.com).

# 9 FER4 - Liquid biostimulant

## 9.1 Product description

Liquid water-soluble biostimulant with free amino acids, organic matter and humic extract

## 9.2 Applications

FER4 is designed to stimulate plant growth, improve nutrient uptake, and enhance soil fertility by combining bioactive compounds, humic substances, and organic matter with nitrogen nutrition. It acts as a biostimulant and soil conditioner, promoting root development, improving nutrient absorption, and enhancing soil structure and microbial activity. Its content of free amino acids can enhance protein synthesis and chlorophyll production, stimulating vegetative growth and plant metabolism. The high organic matter and humic extract improve soil fertility, nutrient availability, and water retention, while also stimulating root development and soil microbial activity. The nitrogen content supports vegetative growth and biomass production, providing an immediate nutrient source for crops.

Suitable for a wide range of crops, including horticultural crops, fruit trees, cereals and vineyards, particularly in soils that require organic enrichment and improved nutrient efficiency. Recommended for application via foliar spray or fertigation systems, allowing efficient nutrient and biostimulant delivery throughout different growth stages.

FER4 supports circular economy strategies and can potentially be used in organic farming.

## 9.3 Product composition

### 9.3.1 General composition and metals

| Composition | Units | Result |
|---|---|---|
| Dry matter | % | 45.00 |
| Total nitrogen | % | 3.90 |
| Free amino acids | % | 10.00 |
| Organic matter | % | 43.00 |
| Humic extract | % | 30.00 |
| Humic acids | % | 4.00 |
| Fulvic acids | % | 26.00 |
| $P_2O_5$ | % | 0.30 |

| | | |
|---|---|---|
| $K_2O$ | % | 0.70 |
| $SO_3$ | % | 4.00 |
| pH | - | 4.56 |
| Cd | mg/kg DM | <1.5 |
| Cr VI | mg/kg DM | <2 |
| Pb | mg/kg DM | <120 |
| Hg | mg/kg DM | <1 |
| Ni | mg/kg DM | <50 |
| As | mg/kg DM | <40 |
| Cu | mg/kg DM | <600 |
| Zn | mg/kg DM | <1500 |

### 9.3.2 Microbiology

| Species | Concentration |
|---|---|
| Salmonella | Not detected |
| Faecal coliforms | <10 UFC/g |
| E. coli | <10 UFC/g |

## 9.4 References

### 9.4.1 Applicable legislation

Regulation (EU) 2019/1009 of the European Parliament and of the Council, which lays down rules on the making available on the market of EU fertilizing products. It is likely classified under Product Function Category (PFC) 6 – Plant biostimulant, given its composition and intended use. As it contains ingredients derived from fishery by-products, it must comply with Regulation (EC) No 1069/2009 (laying down health rules as regards animal by-products and derived products not intended for human consumption) and its implementing Regulation (EU) 142/2011.

For use in organic farming, compliance with Regulation (EU) 2018/848 of the European Parliament and of the Council on organic production and labelling of organic products is required, ensuring that inputs meet organic farming criteria and repealing Council Regulation (EC) No 834/2007. Additionally, products should be authorised in Annex II of the implementing regulation (EU) 2021/1165 authorising certain products and substances for use in organic production.

At national level, Royal Decree RD 506/2013, of 28 June, which establishes rules for the production, marketing and use of fertilizing products that are not CE marked as well as RD 999/2017, which regulates the use of animal by-products and derived products as fertilizer or soil amendments.

### 9.4.2 Product proprietary

Fertinagro Biotech

Polígono Industrial Los Llanos s/n. 44760, Utrillas (Teruel)

Contact: Joaquin Romero (joaquin.romero@tervalis.com), Carlos Fuertes (fuertes.carlos@tervalis.com).

# 10 FER5' - Fertilizer with protein hydrolysate from microalga

## 10.1 Product description

Liquid water-soluble biostimulant with free amino acids, organic matter and microalgae bioactive molecules. Product produced with the protein hydrolysis of microalga biomass generated with tuna cooking wastewaters.

## 10.2 Applications

FER5 was initially designed to enhance soil fertility, stimulate plant metabolism and improve nutrient efficiency by combining humic substances, microalgae bioactive molecules, amino acids and organic matter.

The optimized version of FER5 (FER5') acts as a biostimulant, soil conditioner, and nutrient enhancer, promoting root growth, increasing nutrient uptake efficiency, and improving soil microbial activity and structure. The hydrolysis process included in FER5' permitted to increase the content of free amino acids without external addition which can enhance protein synthesis and chlorophyll production, stimulating vegetative growth and plant metabolism. Moreover, the microalgae fraction provides bioactive compounds that can stimulate plant metabolism, stress tolerance, and soil microbial diversity. The high organic matter enhances soil fertility and structure.

Suitable for a wide range of crops, including horticultural crops, fruit trees, cereals and vineyards, particularly in soils requiring organic enrichment, microbial stimulation, and improved nutrient efficiency. Recommended for application via fertigation and foliar spray, ensuring efficient nutrient and biostimulant delivery throughout the growing cycle.

FER5' supports circular economy strategies and can potentially be used in organic farming.

## 10.3 Product composition

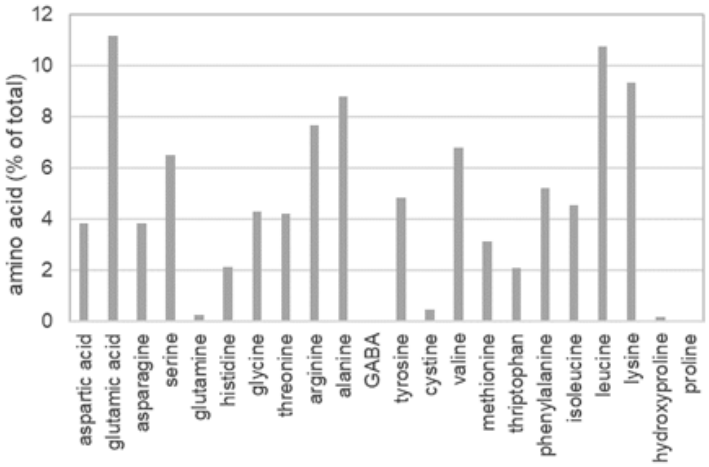
### 10.3.1 General composition and metals

| Composition | Units | Result |
|---|---|---|
| Total nitrogen | % | 0.58 |
| Total amino acids | % | 3.17±0.16 |
| Free amino acids | % | 2.26 |
| Reducing sugars | mg/ml | 14.77±0.17 |

| | | |
|---|---|---|
| pH | - | 5.50 |
| Cd | mg/kg DM | <1.5 |
| Cr VI | mg/kg DM | <2 |
| Pb | mg/kg DM | <120 |
| Hg | mg/kg DM | <1 |
| Ni | mg/kg DM | <50 |
| As | mg/kg DM | <40 |
| Cu | mg/kg DM | <600 |
| Zn | mg/kg DM | <1500 |

### 10.3.2 Amino acid profile

| Amino acid profile | Unit | Free AA |
|---|---|---|
| Threonine | % | 0.095±0.000 |
| Cysteine | % | 0.011±0.005 |
| Tyrosine | % | 0.109±0.000 |
| Valine | % | 0.153±0.001 |
| Methionine | % | 0.070±0.002 |
| Lysine | % | 0.210±0.001 |
| Isoleucine | % | 0.103±0.000 |
| Leucine | % | 0.242±0.000 |
| Phenylalanine | % | 0.118±0.000 |
| Arginine | % | 0.173± 0.001 |
| Alanine | % | 0.198±0.000 |
| Aspartic acid | % | 0.086 ± 0.001 |
| Asparagine | % | 0.086±0.000 |
| Serine | % | 0.146±0.001 |
| Glutamic acid | % | 0.252±0.000 |
| Glutamine | % | 0.006±0.000 |
| Glycine | % | 0.097±0.000 |
| Hydroxyproline | % | 0.004±0.001 |
| Tryptophan | % | 0.047±0.000 |
| Histidine | % | 0.048±0.002 |




### 10.3.3 Microbiology

| Species | Concentration |
|---|---|
| Salmonella | Not detected |
| Faecal coliforms | <10 UFC/g |
| E. coli | <10 UFC/g |

## 10.4 References

### 10.4.1 Applicable legislation

Regulation (EU) 2019/1009 of the European Parliament and of the Council, which lays down rules on the making available on the market of EU fertilizing products. It is likely classified under Product Function Category (PFC) 6 – Plant biostimulant, given its composition and intended use. As microalgae are grown over tuna cooking brines, a fishery by-product, they might be considered a by-product themselves, and thus the derived product must comply with Regulation (EC) No 1069/2009 (laying down health rules as regards animal by-products and derived products not intended for human consumption) and its implementing Regulation (EU) 142/2011.

For use in organic farming, compliance with Regulation (EU) 2018/848 of the European Parliament and of the Council on organic production and labelling of organic products is required, ensuring that inputs meet organic farming criteria and repealing Council Regulation (EC) No 834/2007. Additionally, products should be authorised in Annex II of the implementing regulation (EU) 2021/1165 authorising certain products and substances for use in organic production.

At national level, Royal Decree RD 506/2013, of 28 June, which establishes rules for the production, marketing and use of fertilizing products that are not CE marked as well as

RD 999/2017, which regulates the use of animal by-products and derived products as fertilizer or soil amendments.

### 10.4.2 Product proprietary

NEIKER-BRTA
Parque Tecnológico de Bizkaia, Parcela 812. Berreaga 1. 48160. Derio (BIZKAIA)
Contact: Miriam Pinto (mpinto@neiker.eus)

# 11 UNI1/IP5. Liquid biostimulant

## 11.1 Product description

Concentrated hydrolysate obtained from enzymatic hydrolysis of the organic fraction of discarded molluscs and fish processing by-products. Dark brown colour and molasse texture. A detailed process description is given in D3.8.

## 11.2 Applications

Intermediate product for the formulation of foliar bio-based fertilisers.

## 11.3 Product composition

### 11.3.1 General composition and metals

| Composition | Units | Result |
|---|---|---|
| pH | - | 5.78 ± 0.01 |
| Conductivity | mS/cm | 21.19 ± 0.23 |
| Dry matter | % | 42.12 ± 1.71 |
| Total nitrogen | % | 4.82 ± 0.17 |
| Ammonia N | % | 1.09 ± 0.01 |
| Free amino acids | % | 3.5 ± 0.17 |
| Total amino acids | % | 13 ± 0.17 |
| Ash | % | 10.15 ± 0.21 |
| $K_2O$ | % | 0.73 ± 0.01 |
| Na | % | 0.97 ± 0.04 |
| $P_2O_5$ | % | 0.74 ± 0.02 |
| $SO_4$ | % | 1.32 ± 0.02 |
| Cd | mg/kg DM | n.d. |
| Ni | mg/kg DM | n.d. |
| Cu | mg/kg DM | 148.5 ± 6.89 |
| Cr | mg/kg DM | n.d. |
| Zn | mg/kg DM | 640.8 ± 7.03 |
| Hg | mg/kg DM | 0.4 ± 0.00 |
| Pb | mg/kg DM | n.d. |

### 11.3.2 Amino acid profile

| Amino acid profile | Unit | Total AA | Free AA |
|---|---|---|---|
| Thr | % | n.d. | 0.0076± 0 |

| Amino acid profile | Unit | Total AA | Free AA |
|---|---|---|---|
| Cys | % | 0.509 ± 0.003 (CysH) | 0.142 ± 0.001 (Cys) |
| Tyr | % | 3.59 ± 0.004 | 0.729 ± 0.001 |
| Val | % | 0.474 ± 0.001 | 0.17 ± 0 |
| Met | % | n.d. | 0.089 ± 0.001 |
| Lys | % | 0.418 ± 0.003 | 0.097 ± 0.003 |
| Ile | % | 1.07 ± 0.001 | 0.102 ± 0.001 |
| Leu | % | 1.07 ± 0.006 | 0.245 ± 0 |
| Phe | % | 0.518 ± 0 | 0.181 ± 0.001 |
| Arg | % | 0.1 ± 0.002 | 0.018 ± 0 |
| Ala | % | 0.672 ± 0.001 | 0.409 ± 0.001 |
| Asp | % | 0.243 ± 0 | 0.02 ± 0.002 |
| Ser | % | 0.172 ± 0.001 | 0.013 ± 0.002 |
| Glu | % | 2.24 ± 0.007 | 0.296 ± 0.001 |
| Gly | % | 2.27 ± 0.04 | 0.689 ± 0.002 |
| Pro | % | 0.172 ± 0 | 0.013 ± 0 |
| His | % | 0.139 ± 0 | 0.039 ± 0.001 |
| Trp | % | 0.14 ± 0.022 | 0.271 ± 0.004 |

### 11.3.3 Molecular size profile

| MW kDa | % |
|---|---|
| >6.7 | 45 % |
| 6.7-1.7 | 24 % |
| 1.7-1 | 13 % |
| < 1 | 18 % |

### 11.3.4 Microbiology

| Species | Concentration |
|---|---|
| Salmonella | Not detected |
| Faecal coliforms | <10 UFC/g |
| E. coli | <10 UFC/g |

## 11.4 References

### 11.4.1 Applicable legislation

Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation) and its implementing Regulation (EU) 142/2011.

Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 and repealing Regulation (EC) No 2003/2003.

Italian Legislation D.Lgs 75/2010, of 29 April, on fertilizer products. Italian Ministry of Presidency.

### 11.4.2 Product proprietary

Università Politecnica delle Marche
Dipartimento di Scienze ed Ingegneria della Materia, dell'Ambiente ed Urbanistica (SIMAU), Via Brecce Bianche 12, 60131 Ancona - Italy,
Contact: Francesco Fatone (f.fatone@univpm.it

# 12 UNI5/IP6. Organic soil amendment or soil improver

## 12.1 Product description

Biochar obtained by slow pyrolysis of fish processing leftovers with agricultural pruning by-products. Dry product with a dark black color and a porous structure. A detailed process description is given in D3.8.

## 12.2 Applications

Stable, carbon-rich material. Application to soil to enhance carbon sequestration, improve nutrient retention, increase water-holding capacity, and optimise overall soil structure and fertility.

## 12.3 Product composition

### 12.3.1 General composition and metals

| Composition | Units | Result |
|---|---|---|
| pH | - | 9.41 ± 0.08 |
| Conductivity | mS/cm | 48.60 ± 0.33 |
| Dry matter | % | 94.20± 0.00 |
| Ash | % | 19.20 ± 0.00 |
| Water holding capacity | % | 156.5± 0.00 |
| Fixed carbon | % | 11.20 ± 0.00 |
| Total carbon | % | 62.80± 0.00 |
| Total nitrogen | % | 3.90 ± 0.00 |
| Total hydrogen | % | 3.6 ± 0.00 |
| H/C (molar ratio) | - | 0.69 |
| Cd | mg/kg DM | <LOQ |
| Hg | mg/kg DM | n.d. |
| Ni | mg/kg DM | 16.4±4.2 |
| Pb | mg/kg DM | <LOQ |
| As | mg/kg DM | <LOQ |
| Cu | mg/kg DM | 30.5±10.3 |
| Zn | mg/kg DM | 138.7±39.7 |
| Cr (VI) | mg/kg DM | <2 |

### 12.3.2 Macronutrient Profile

| Composition | Units | Result |
|---|---|---|
| $Na_2O$ | % | 0.74 ± 0.21 |
| $K_2O$ | % | 1.21 ± 0.36 |
| $P_2O_5$ | % | 0.93 ± 0.26 |
| CaO | % | 4.22 ± 1.26 |
| MgO | % | 0.20 ± 0.05 |

## 12.4 References

### 12.4.1 Applicable legislation

Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation) and its implementing Regulation (EU) 142/2011.

Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 and repealing Regulation (EC) No 2003/2003.

Italian Legislation D.Lgs 75/2010, of 29 April, on fertilizer products. Italian Ministry of Presidency.

### 12.4.2 Product proprietary

Università Politecnica delle Marche
Dipartimento di Scienze ed Ingegneria della Materia, dell'Ambiente ed Urbanistica (SIMAU), Via Brecce Bianche 12, 60131 Ancona - Italy,
Contact: Francesco Fatone (f.fatone@univpm.it)

# 13 UNI2. Soil improver

## 13.1 Product description

Compost-biochar composite obtained from fish processing by-products mixed with agricultural by-products and amended with biochar. Product with dark brown color and crumbly texture. A detailed process description is given in D3.8.

## 13.2 Applications

Organic soil improver to improve soil physiochemical properties.

## 13.3 Product composition

### 13.3.1 General and metal composition

| Composition | Units | Result |
|---|---|---|
| Dry matter | % | 90.17 ± 0.07 |
| pH | | 7.15 ± 0.04 |
| Electrical conductivity | mS/cm | 2.1 ± 0.03 |
| Organic carbon | % | 43.89 ± 1.11 |
| Total Nitrogen | % | 2.93 ± 0.11 |
| Ammonia N | % | 0.58 ± 0.008 |
| Organic Nitrogen | % | 2.89 ± 0.11 |
| Corg/N | - | 14.96 |
| $P_2O_5$ | % | 1.08 ± 0.17 |
| $K_2O$ | % | 0.9 ± 0.07 |
| Cd | mg/kg DM | 0.52 ± 0.18 |
| Cr | mg/kg DM | 18.79 ± 5.23 |
| Cr (VI) | mg/kg DM | < 2 |
| Cu | mg/kg DM | 48.15 ± 4.65 |
| Hg | mg/kg DM | n.d. |
| Ni | mg/kg DM | 15.11 ± 2.55 |
| Pb | mg/kg DM | 6.46 ± 4.02 |
| As | mg/kg DM | 3.27 ± 0.2 |
| Zn | mg/kg DM | 103 ± 13 |

### 13.3.2 Microbiology

| Species | Units | Concentration |
|---|---|---|
| Salmonella | CFU/25 g | Not detected |
| E. coli | CFU/g | <10 UFC/g |

### 13.3.3 Particle size

| Size fraction | Units | Result |
|---|---|---|
| <1 mm | % DM | 36 ± 4 |
| 1-2mm | % DM | 40 ± 2 |
| 2-4 mm | % DM | 23 ± 2 |
| 4-10 mm | % DM | 1 ± 0 |

## 13.4 References

### 13.4.1 Applicable legislation

Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation) and its implementing Regulation (EU) 142/2011.

Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 and repealing Regulation (EC) No 2003/2003.

Italian Legislation D.Lgs 75/2010, of 29 April, on fertilizer products. Italian Ministry of Presidency.

### 13.4.2 Product proprietary

Università Politecnica delle Marche

Dipartimento di Scienze ed Ingegneria della Materia, dell'Ambiente ed Urbanistica (SIMAU), Via Brecce Bianche 12, 60131 Ancona - Italy,

Contact: Francesco Fatone (f.fatone@univpm.it)

# 14 UNI4/IP8. Liming agent

## 14.1 Product description

Liming agent obtained from mollusc shells mechanically and physically separated from the raw mollusc by-products. White powder rich in Calcium carbonate. A detailed process description is given in D3.8.

## 14.2 Applications

Correction of soil acidity.

## 14.3 Product composition

### 14.3.1 General composition and metals

| Composition | Units | Result |
|---|---|---|
| grain size < 1 mm | % | 100 |
| Dry matter | % | 99.66 ± 0.04 |
| CaO | % | 49.77 ± 0.91 |
| MgO | % | 0.41 ± 0.03 |
| Cd | mg/kg DM | < 0.83 |
| Cr | mg/kg DM | < 1.06 |
| Cu | mg/kg DM | < 3.75 |
| Hg | mg/kg DM | 0.01 |
| Ni | mg/kg DM | < 1.04 |
| Pb | mg/kg DM | < 2.66 |
| As | mg/kg DM | 0.23 |
| Zn | mg/kg DM | < 0.62 |
| Neutralizing value | (Equivalent to CaO) | 56.18 |
| Soil lime efficiency (CaCO3)** | - | 0.822 ± 0.036 |
| Soil lime efficiency (CaO)** | - | 0.554 ± 0.023 |

## 14.4 References

### 14.4.1 Applicable legislation

Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation) and its implementing Regulation (EU) 142/2011.

Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 and repealing Regulation (EC) No 2003/2003.

Italian Legislation D.Lgs 75/2010, of 29 April, on fertilizer products. Italian Ministry of Presidency. Updated with D.M. of 10 October 2022.

### 14.4.2 Product proprietary

Università Politecnica delle Marche
Dipartimento di Scienze ed Ingegneria della Materia, dell'Ambiente ed Urbanistica (SIMAU), Via Brecce Bianche 12, 60131 Ancona - Italy,
Contact: Francesco Fatone (f.fatone@univpm.it

# 15 BP/IP10. Organic fertilizer bokashi pellet

## 15.1 Product description

Organic granules obtained from bokashi fermentation of fish waste mixed with tree leaves, ash and food waste from HORECA. Brown in colour.

## 15.2 Applications

Apply 1000 kg of biogranule per hectare. Better results when mixed with the soil.

## 15.3 Product composition

### 15.3.1 General composition and metals

| Composition | Units | Result |
|---|---|---|
| pH | | 7.21±0.04 |
| Dry matter content | % | 90.65±2 |
| Moisture content | % | 9.35±0.17 |
| Ash content | % | 38.15±1.28 |
| Organic matter content | % | 61..85±1.28 |
| EC | mS/cm | 5.87±0.22 |
| TN | % | 2.63±0.09 |
| NH4+-N | g/kg | 0.38±0.02 |
| NO3--N | g/kg | <0.002 |
| $P_2O_5$ | % | 2.41±0.87 |
| $K_2O$ | g/kg | 23.47±2.04 |
| Ca | g/kg | 66.10±5.17 |
| Mg | g/kg | 6.20±0.83 |
| Na | g/kg | 15.38±0.69 |
| S | % | 0.25±0.01 |
| Fe | mg/kg | 4081.40±1404.53 |
| Cu | mg/kg DM | 12.36±9.22 |
| Co | mg/kg | <2.49 |
| Mn | mg/kg | 508.85±73.99 |
| Zn | mg/kg | 191.64±6.34 |

| | | |
|---|---|---|
| Al | mg/kg | 3271.38±434.42 |
| Cd | mg/kg DM | <0.83 |
| Cr | mg/kg DM | 18.63±7.35 |
| Pb | mg/kg DM | <2.66 |
| Ni | mg/kg DM | <1.04 |

### 15.3.2 Amino, humic and fulvic acid profile

**Content of humic and fulvic acids**

| | | |
|---|---|---|
| Humic acid | 10.15 | % |
| Total Humic Extract | 30.73 | % |
| Fulvic acid | 20.58 | % |

**Content of free amino acids**

| **Free AA** | **Unit** | **Result** |
|---|---|---|
| Alanine | % | 0.109 |
| Cystine | % | 0.021 |
| Glycine | % | 0.033 |
| Isoleucine | % | 0.020 |
| Leucine | % | 0.041 |
| Methionine | % | 0.015 |
| Proline | % | 0.035 |
| Taurine | % | 0.030 |
| Threonine | % | 0.012 |
| Valine | % | 0.032 |
| **Total** | % | **0.348** |

### 15.3.3 Microbiology

**Pathogens**

| Species | Concentration |
|---|---|
| Salmonella | n. d. |
| Faecal coliforms | <10 |
| E. coli | <10 |

**Beneficial microbial community**

| Taxonomic level | Taxonomic unit | Normalized fraction |
|---|---|---|
| s | Levilactobacillus brevis | 0.422261 |
| s | Lactiplantibacillus plantarum | 0.070434 |
| g | Lacticaseibacillus spp | 0.069577 |
| s | Lentilactobacillus parafarraginis | 0.043743 |
| g | Paenibacillus spp | 0.037102 |
| s | Pediococcus parvulus | 0.031961 |
| s | Pantoea agglomerans | 0.029476 |
| g | Loigolactobacillus coryniformis | 0.022793 |
| s | Xanthobacter polyaromaticivorans | 0.014995 |
| | **Lactic acid bacteria** | **0.660769** |

## 15.4 References

### 15.4.1 Applicable legislation

Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products, amending Regulations (EC) No 1069/2009 and Estonian Ministry of Environment Regulation on compost producing from biowaste (08/04/2013 - Biolagunevatest jäätmetest komposti tootmise nõuded).

Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived

products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation) and its implementing Regulation (EU) 142/2011.

### 15.4.2 Product proprietary

OÜ Nutriloop

Tööstuse tn 47a-89, Tallinn, 10416 Estonia

Contact: Marie Soone (marie@nutriloop.org)

# 16 FS/IP11. Foliar spray obtained through bokashi fermentation of fish waste mixed with other organic wastes

## 16.1 Product description

Biowaste fermentation liquid obtained from bokashi fermentation of fish waste food waste from HORECA. Light yellow colour.

## 16.2 Applications

Can be applied to the soil or foliage with dosage of 5 litres per hectare.

## 16.3 Product composition

### 16.3.1 General composition and metals

| Composition | Units | Result |
|---|---|---|
| pH | | 3.88±0.02 |
| Dry matter content | % | 1.92±0.17 |
| Moisture content | % | 98.08±0.17 |
| TN | % | 0.12±0.00 |
| $NH_4$+-N | g/kg | 0.27±0.01 |
| $NO_3$--N | g/kg | 0.007±0.002 |
| $P_2O_5$ | % | 0.16±0.00 |
| $K_2O$ | g/kg | 1.76±0.01 |
| Ca | g/kg | 0.16±0.00 |
| Mg | g/kg | 0.09±0.00 |
| Na | g/kg | 0.36±0.00 |
| S | % | 0.02±0.00 |
| Fe | mg/kg | 22.72±0.41 |
| Cu | mg/kg DM | <0.02 |
| Co | mg/kg | <0.02 |
| Mn | mg/kg | 1.17±0.02 |
| Zn | mg/kg DM | 233.85±4.17 |

| | | |
|---|---|---|
| Al | mg/kg | 2.59±0.12 |
| Cd | mg/kg DM | <0.01 |
| Cr | mg/kg DM | <0.01 |
| Pb | mg/kg DM | <0.02 |
| Ni | mg/kg DM | < 0.01 |

### 16.3.2 Amino, humic and fulvic acid profile

### Content of humic and fulvic acids

| | | |
|---|---|---|
| Humic acid | 0.14 | % |
| Total Humic Extract | 0.97 | % |
| Fulvic acid | 0.83 | % |

### Content of free amino acids

| **Free AA** | **Unit** | **Result** |
|---|---|---|
| Alanine | % | 0.023 |
| Arginine | % | 0.010 |
| Aspartic acid | % | 0.028 |
| Glutamic acid | % | 0.041 |
| Leucine | % | 0.010 |
| Lysine | % | 0.011 |
| Proline | % | 0.039 |
| Taurine | % | 0.009 |
| Threonine | % | 0.006 |
| Valine | % | 0.011 |
| **Total** | **%** | **0.188** |

### 16.3.3 Microbiology

#### Pathogens

| Species | Concentration |
|---|---|
| Salmonella | n. d. |
| Faecal coli | <10 |
| E. coli | <10 |

#### Beneficial microbial community

| Taxonomic level | Taxonomic unit | Normalized fraction |
|---|---|---|
| s | Lactiplantibacillus plantarum | 0.435751 |
| s | Leuconostoc gelidum | 0.385238 |
| s | Companilactobacillus farciminis | 0.0512 |
| g | Leuconostoc spp | 0.035822 |
| g | Lactiplantibacillus spp | 0.020037 |
| g | Latilactobacillus spp | 0.019503 |
| s | Leuconostoc mesenteroides | 0.014207 |
| g | Paucilactobacillus spp | 0.013163 |
| s | Levilactobacillus brevis | 0.008504 |
| s | Latilactobacillus fuchuensis | 0.004405 |
| | **Lactic acid bacteria** | **0.9873** |

## 16.4 References

### 16.4.1 Applicable legislation

Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products, amending Regulations (EC) No 1069/2009 and Estonian Ministry of Environment

Regulation on compost producing from biowaste (08/04/2013 - *Biolagunevatest jäätmetest komposti tootmise nõuded*).

Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation) and its implementing Regulation (EU) 142/2011.

### 16.4.2 Product proprietary

OÜ Nutriloop
Tööstuse tn 47a-89, Tallinn, 10416 Estonia
Contact: Marie Soone (marie@nutriloop.org)

# 17 VER/IP12. Vermicompost obtained through bokashi fermentation and vermicomposting

## 17.1 Product description

Vermicompost obtained from bokashi fermentation of fish and food waste from HORECA mixed with tree leaves. Black colour.

## 17.2 Applications

Apply dosage of 11664 kilos per hectare.

## 17.3 Product composition

### 17.3.1 General composition and metals

| Composition | Units | Result |
|---|---|---|
| pH | | 7.22±0.06 |
| Dry matter content | % | 45.54±0.28 |
| Moisture content | % | 54.46±0.28 |
| Ash content | % | 66.83±0.76 |
| Organic matter content | % | 33.17±0.76 |
| EC | µS/cm | 941.33±0.98 |
| TN | % | 0.89±0.06 |
| $NH_4^+$-N | g/kg | 0.11±0.00 |
| $NO_3^-$-N | g/kg | <0.002 |
| $P_2O_5$ | % | 0.60±0.02 |
| $K_2O$ | g/kg | 12.12±0.66 |
| Ca | g/kg | 24.51±1.84 |
| Mg | g/kg | 4.01±0.21 |
| Na | g/kg | 11.88±0.75 |
| S | % | 0.16±0.01 |
| Fe | mg/kg | 8726.75±425.57 |
| Cu | mg/kg DM | 120.88±0.66 |
| Co | mg/kg | <2.49 |
| Mn | mg/kg | 299.11±31.57 |

| | | |
|---|---|---|
| Zn | mg/kg DM | 507.69±42.01 |
| Al | mg/kg | 8688.12±363.02 |
| Cd | mg/kg DM | <0.83 |
| Cr | mg/kg DM | 22.82±2.37 |
| Pb | mg/kg DM | <2.66 |
| Ni | mg/kg DM | <1.04 |

### 17.3.2 Humic and fulvic acid profile

| | | |
|---|---|---|
| Humic acid | 1.37 | %DM |
| Total Humic Extract | 4.33 | %DM |
| Fulvic acid | 2.96 | %DM |

### 17.3.3 Microbiology

| Species | Concentration |
|---|---|
| Salmonella | n. d. |
| Faecal coliforms | <10 |
| E. coli | <3 |

## 17.4 References

### 17.4.1 Applicable legislation

Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products, amending Regulations (EC) No 1069/2009 and Estonian Ministry of Environment Regulation on compost producing from biowaste (08/04/2013 - *Biolagunevatest jäätmetest komposti tootmise nõuded*).

Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No

1774/2002 (Animal by-products Regulation) and its implementing Regulation (EU) 142/2011.

### 17.4.2 Product proprietary

OÜ Nutriloop
Tööstuse tn 47a-89, Tallinn, 10416 Estonia
Contact: Marie Soone (marie@nutriloop.org)

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## PROJECT PARTNERS

NEIKER MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE
barna
PIRINEA
NUTRILOOP
AZTI MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE
CATAR AGRO RESSOURCES
UNIVERSITÀ POLITECNICA DELLE MARCHE
AQUABIOTECH GROUP
UNIVERSITAT DE VIC UNIVERSITAT CENTRAL DE CATALUNYA
Beta Biodiversitat, Ecologia, Tecnologia Ambiental i Alimentària
FERTINAGRO BIOTECH
grönn gjødsel
NIBIO NORWEGIAN INSTITUTE OF BIOECONOMY RESEARCH
iSQ
INP TOULOUSE
GHENT UNIVERSITY
Estonian Crop Research Institute
UNIVERSITÀ DEGLI STUDI DI MILANO
AGRICULTURES & TERRITOIRES CHAMBRE D'AGRICULTURE PYRÉNÉES-ATLANTIQUES
FiBL Switzerland
LIÈGE université Gembloux Agro-Bio Tech
Norsk Landbruksrådgiving
iniciativas innovadoras
Ministerio de Agricultura Gobierno de Chile
INIA
FiBL Europe
IPS KONZALTING
CO·PE·MO COOPERATIVA PESCATORI MOLLUSCHICOLTORI