USAMVB Timisoara
Multidisciplinary Conference on Sustainable Development
May 25-26, 2023.

MULTIDISCIPLINARY CONFERENCE ON SUSTAINABLE DEVELOPMENT 2023

ARISTOTLE UNIVERSITY OF THESSALONIKI

LABORATORY OF INORGANIC CHEMISTRY AND ADVANCED MATERIALS

Seaweed and ground fish bone product characterization and antioxidant activity as potential plant growth stimulants in agriculture

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Abstract: Seaweed and fish residuals, generated through industrial processing, have been widely targeted as biostimulants in crop management due to their growth-promoting and stress-resistant effects **[1]**. In the literature, they have been pointed out as rich sources of natural antioxidants **[2]**. Thus, Blue bio-product materials collected from the Scandinavian coast have been used for identifying molecular and (non)metal ionic components being able to support-enhance plant growth. To that end, Low and High Nitrogen Algal Cake have exhibited a positive effect on ryegrass growth **[3]**.

Introduction

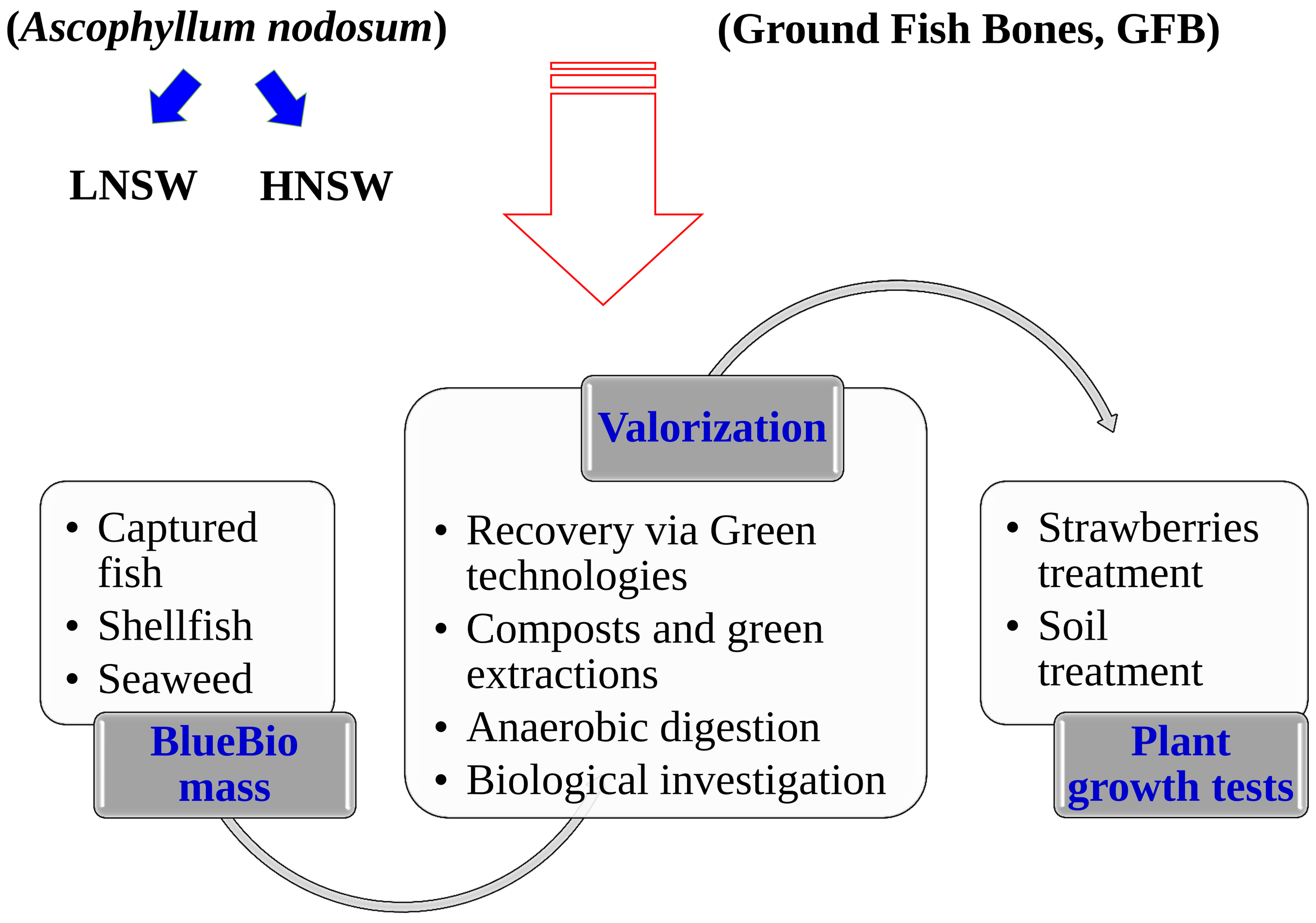
The novel idea of this project is the valorization of (chemically and biologically well-defined) mixed residual materials into BLUE based fertilizers and biostimulants for the GREEN sector. Such products are already widely applied in many regions of the world, with the potential for a broader application in Europe being significant. Mixing seaweeds and other BLUE materials into plant promoting products is also highly innovative, since most currently available products come from fish waste or seaweed. The project includes an innovative technology applied to obtain RAS cake, which will lead to higher dry matter content in the organic fish waste, lower cost for transportation/storage, recovery of P, and valorization of this cake as an organic fertilizer. Accordingly, this innovative technology will improve the development of value chain concept in land-based RAS. Consequently, preparing soil amenders by impregnating biochar with BLUE input emerges as a new approach to contemporary agricultural practices.

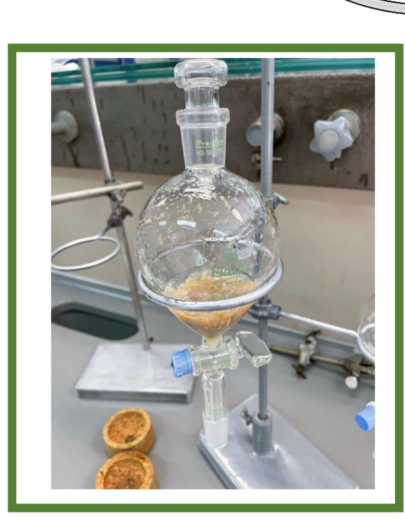
Material and method

Algal cake from rockweed (*Ascophyllum nodosum*)

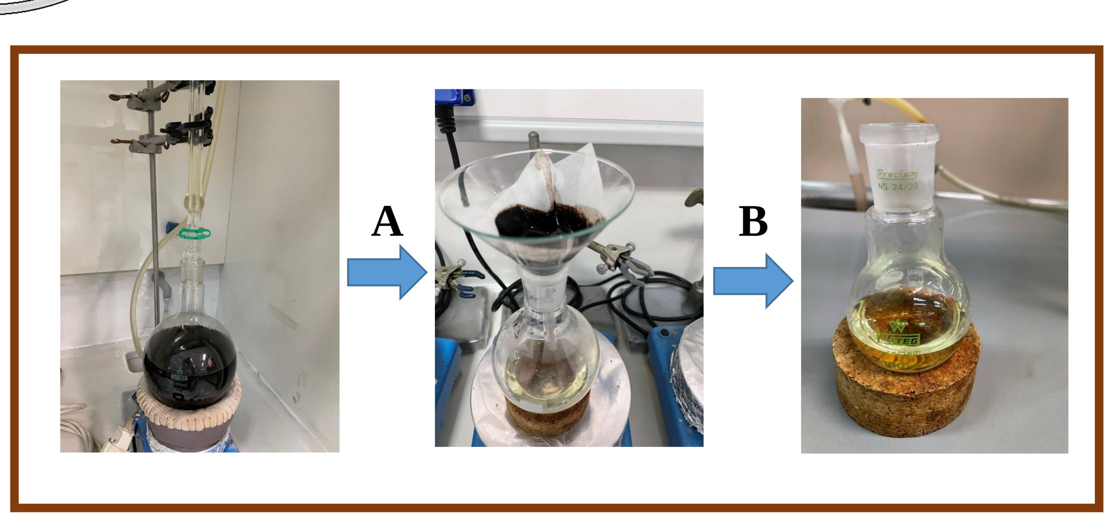
Fish residue (Ground Fish Bones, GFB)

LNSW HNSW



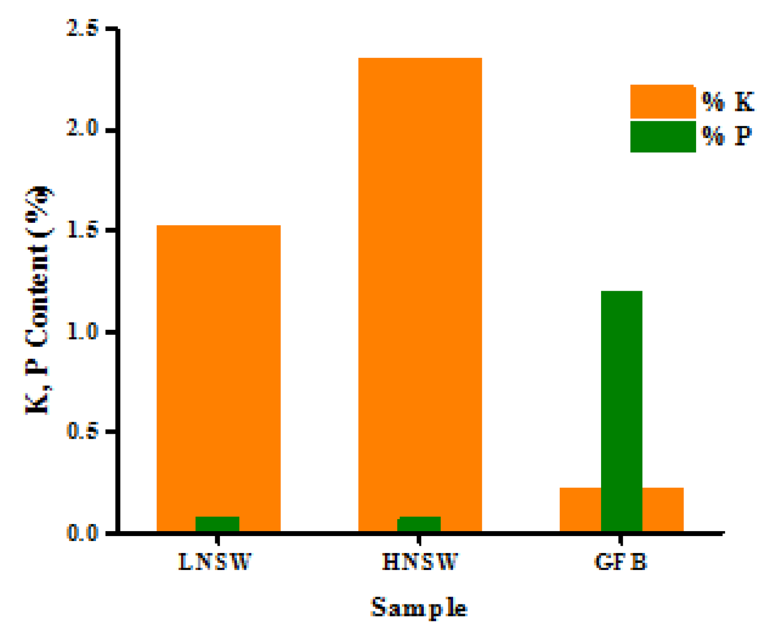


Extraction with Ethyl Acetate & Hexane

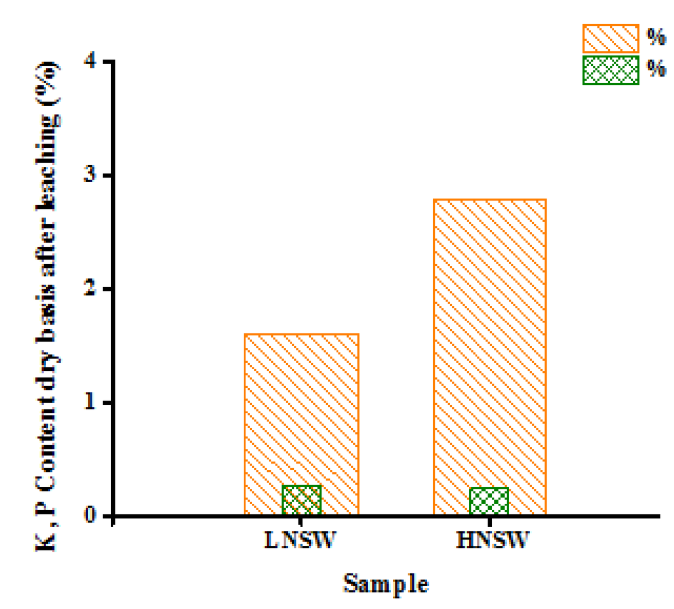


Acid Hydrolysis

Results and Discussion

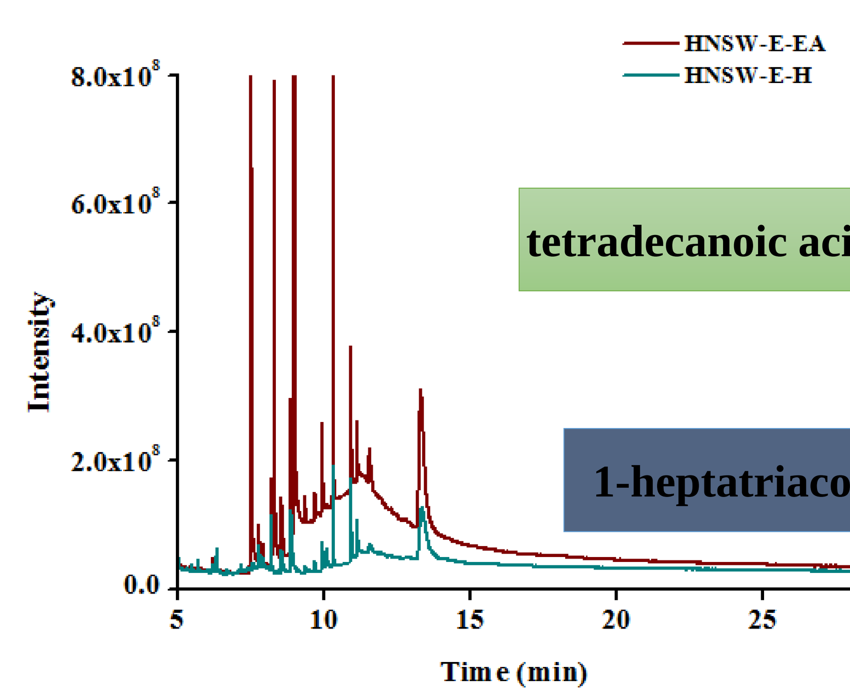


Original samples



Samples after leaching

GC-MS analysis of samples extracted through Ethyl Acetate (EA) and Hexane (H)



tetradecanoic acid | phytol | arachidonic acid | 2-pentadecanone | cis-13-octadecenoic acid | 1-heptatriacontanol | 6,10,14-trimethyl-pentadecanoic acid

	Element (concentration)	HNSW	LNSW	GFB
Nutrients	K (% w/w)	2.35±0.10	1.52±0.09	0.22±0.01
	Ca (% w/w)	1.05±0.17	2.22±0.37	2.06±0.34
	Mg (% w/w)	0.55±0.10	0.32±0.06	0.05 ±0.01
	Na (% w/w)	0.45±0.08	0.34±0.06	0.27±0.05
	P (% w/w)	0.07±0.01	0.08±0.02	1.20±0.24
	Fe (mg/kg)	29.5±6.6	28.3±6.3	8.5±1.9
	Mn (mg/kg)	13.2±1.7	7.9±1.0	< 0.5
	Cu (mg/kg)	1.3±0.3	1.0±0.2	< 1.0
	Zn (mg/kg)	21.5±3.1	12.2±1.8	12±1.7
	Se (mg/kg)	< 1.0	< 1.0	< 1.0
	Si (mg/kg)	215.8±42.7	83.8±16.6	63.7±12.6
	Al (mg/kg)	37.4±5.6	19.5±2.91	3.6±0.5
	Co (mg/kg)	< 0.5	< 0.5	< 0.5
	Mo (mg/kg)	< 0.5	< 0.5	< 0.5
	B (mg/kg)	43.1±9.7	23.6±5.3	10.1±2.3
	S (% w/w)	0.31±0.04	0.26±0.04	0.16±0.02

Plant Growth tests of extracts

Conclusions

- Measurements of the inorganic and organic elements were pursued through ICP-MS and ICP-OES methodologies.
- Physical and chemical composition analyses reveal key information pertaining to the nature of the BlueBio materials (HNSW, LNSW and GFB).
- The so produced physicochemical profile of the seaweed and fish bone samples justifies their subsequent use in in vitro and in vivo biological experiments.
- The collective chemical and biological profiles are expected to formulate appropriate BlueBio mixtures as crop plant stimulants in modern agricultural practices.

Literature

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2. P.A. Corsetto, G. Montorfano, S. Zava, I. Colombo, B. Ingadottir, R. Jonsdottir, K. Sveinsdottir, A.M. Rizzo, Antioxidants (Basel), 9(3) (2020) 249.
3. I. Ahuja, A.-K. Løes, Effect of fish bones and algae fibre as fertilisers for ryegrass. Norwegian Centre for Organic Agriculture (NORSØK) Report Vol. 4 No. 7 2019, 64 p. Tingvoll, Norway.

Acknowledgement: This work is part of the project MARIGREEN, which has received funding from the European Union's Horizon 2020 research and innovation program under agreement 817992 and GSRI (T12EPA5-00071).