Protein recovery from animal by-products in tannery and rendering industries for biostimulant applications in agriculture

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1. PROBLEM AND IMPACT

RENDERING AND TANNING IMPACT

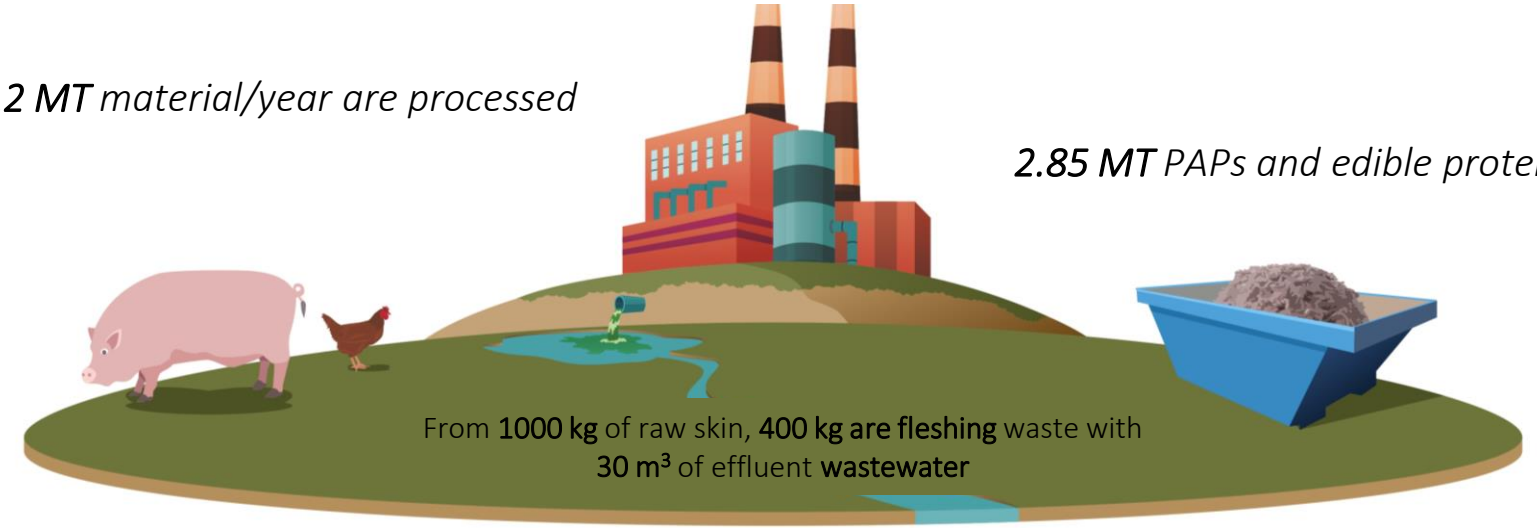
Around **60%*** of each animal is converted into food for **human consumption.**

REMAINING **40% becomes animal by-products (ABPs)** transformed by the rendering industry into high added value products.

High-protein wastewater

***12 MT** material/year are processed*

***2.85 MT** PAPs and edible proteins*

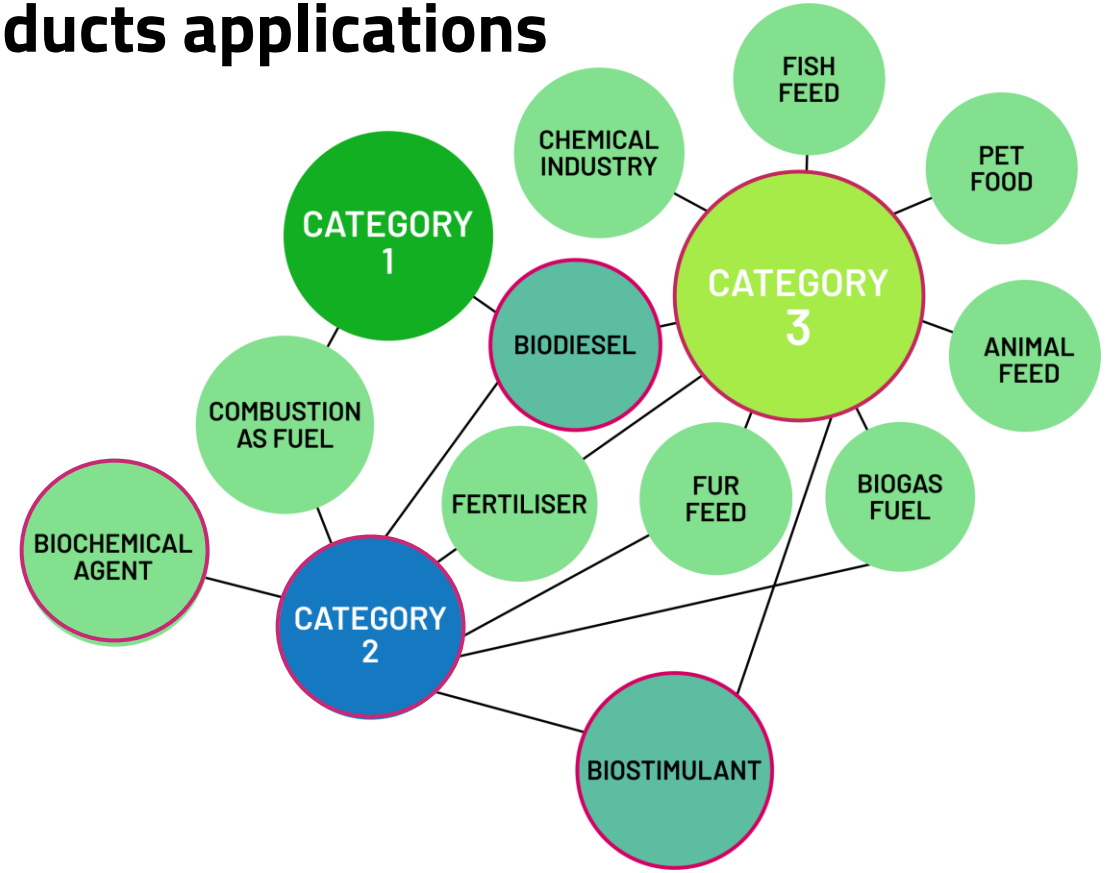


From **1000 kg** of raw skin, **400 kg are fleshing** waste with **30 m³** of effluent **wastewater**

*328 million livestock European

Fat Processors and Renderers Association (EFPRA), 2021 and Kanagaraj, 2015

Animal by-products applications



According European Regulation Nº1069/2009

By-products valorisation into PAP

ABPs waste were previously pressure-sterilised through a method 1 transformation in compliance with Regulation (EC) No 1069/2009

High-protein wastewater category 3 from rendering industry

Flesh liming category 3 from tanning industry

Meat and Bone meal category 2 from rendering industry

Production of advanced biodiesel from animal wastes using supercritical technologies

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lifesuperbiodiesel.eu

Protein recovery and recycling from animal by-products processes

BYPROTVAL

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INESCOP CENTRO TECNOLÓGICO DEL CALZADO

Trumpler Creamos buena química

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Energygreen Gas Almazan S.L.

Otivar

2. VALORISATION METHOD

ENZYMATIC HYDROLYSIS FOR RECOVERY PROTEINS AS BIOSTIMULANTS*

Preparation and characterization**

**pH, ash, moisture content, total and free aminoacids, organic material and nitrogen. Total nitrogen, ammonium nitrogen and organic nitrogen.

Method 1***

Method 5***

Enzymatic Hydrolysis

Proteolytic enzyme with endo and ezo-activity

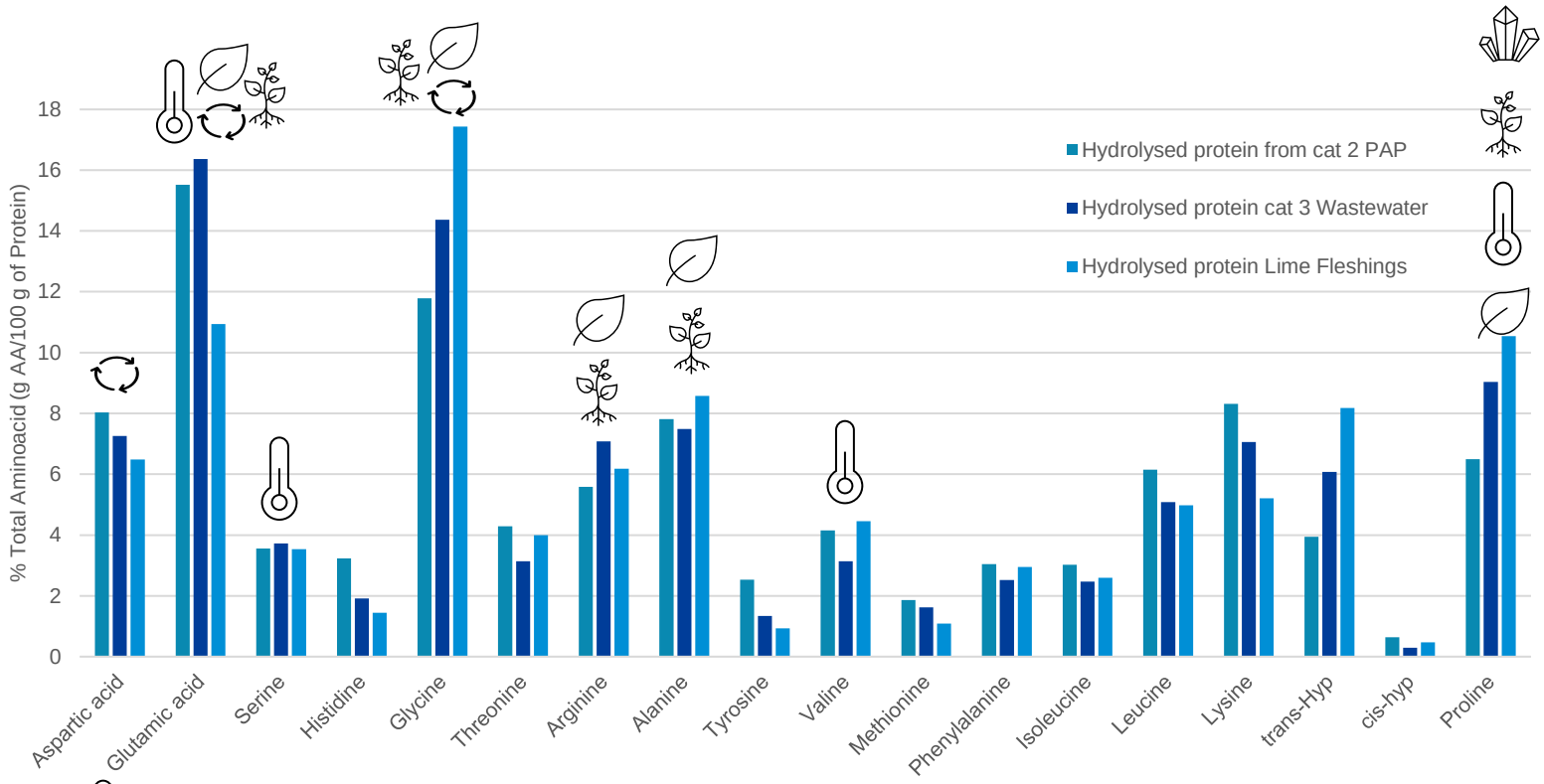
Mechanical separation

*Regulation (EU) No 142/2011
***Regulation (EU) 1069/2009
****Regulation (EU) 2019/1009

COMPARISON OF THE PARAMETERS CORRESPONDING TO DIFFERENT ANIMAL BY-PRODUCT USED

Parameter	Biostimulant obtained from Cat 2 PAP	Biostimulant obtained from Cat 3 wastewater	Biostimulant obtained from Fleshings
Protein yield (%)	87.50	97.22	78.18
Total nitrogen (%)	7.43	7.54	8.05
Ammonia nitrogen (%)	0.22	0.625	0.625
Organic nitrogen (%)	5.13	7.41	7.41
Urea nitrogen (%)	0.008	0.05	0.05
Total amino acids (% in dry matter)	70.68	60.72	68.06
Free amino acids (%) in solution	3.53	5.09	4.67
Dry matter (%)	57.52	56.74	67.25
Organic matter (%)	53.38	55.85	77.85
Ashes (% in dry matter)	7.8	7.3	10.5
Density (kg/L)	1.24	1.23	1.25
pH	5.6	5.7	5.7

AMINOACID PROFILE CORRESPONDING TO HYDROLYSED PRODUCT OBTAINED FROM DIFFERENT ANIMAL BY-PRODUCT



Plant Growth

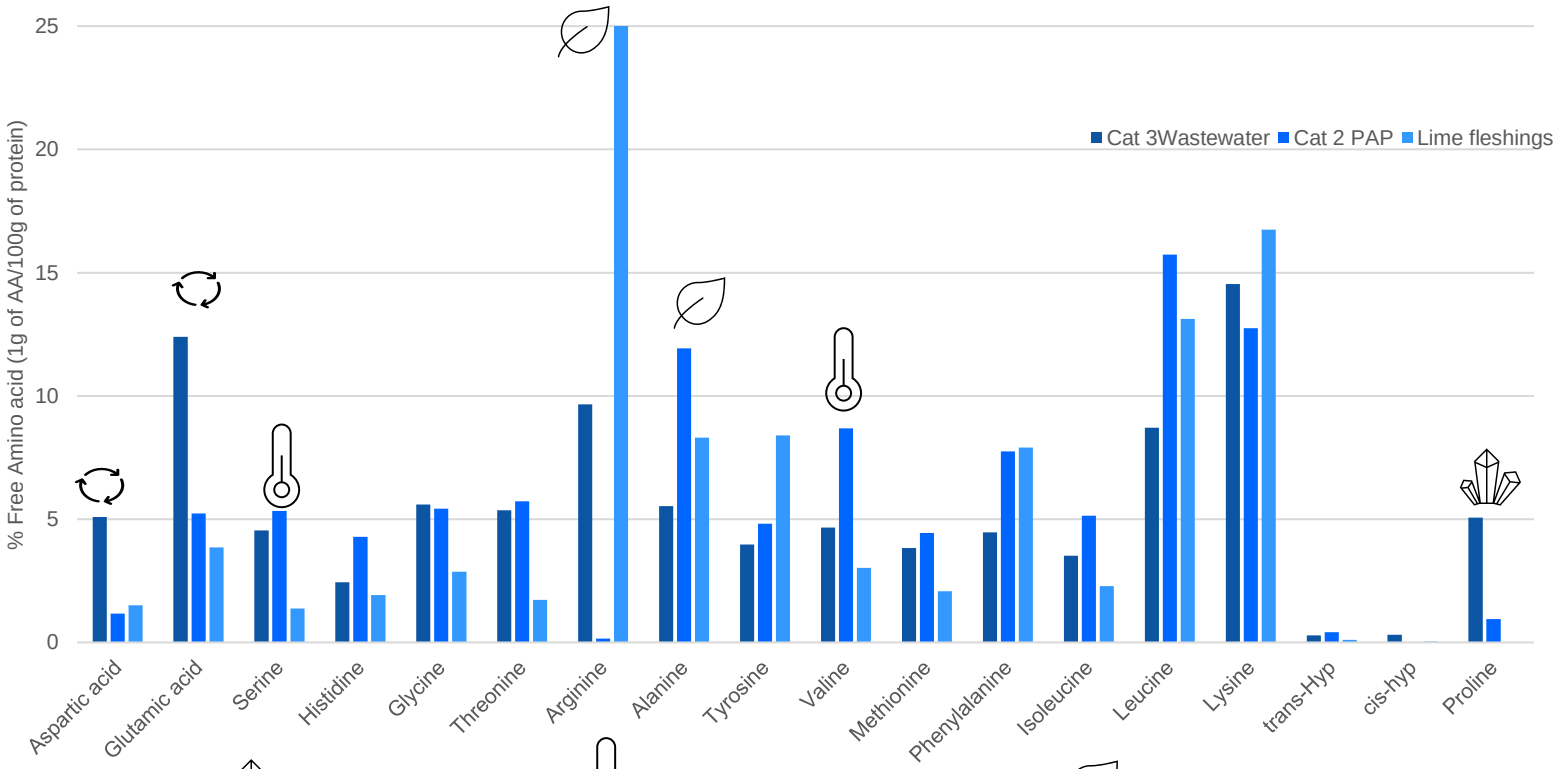
High temperatures effect mitigation

Improve chlorophyll production

Improve nutrient uptake

Salinity stress mitigation

FREE AMINOACID PROFILE CORRESPONDING TO HYDROLYSED PRODUCT OBTAINED FROM DIFFERENT ANIMAL BY-PRODUCT



Improve nutrient uptake

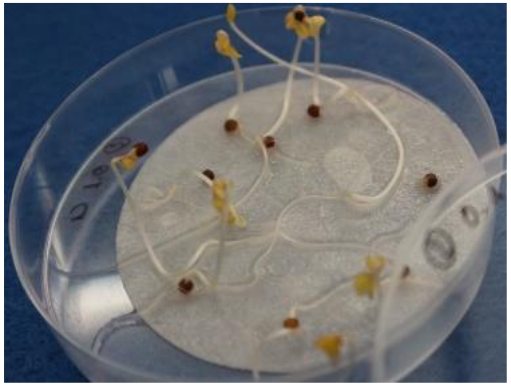
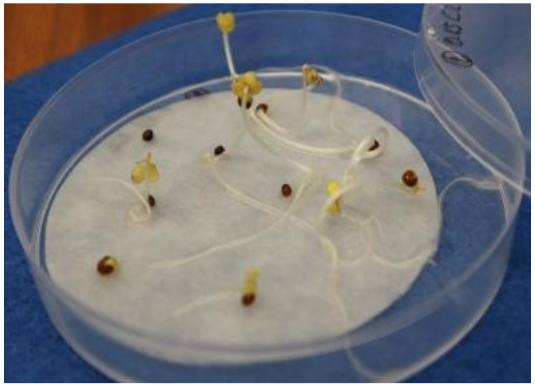
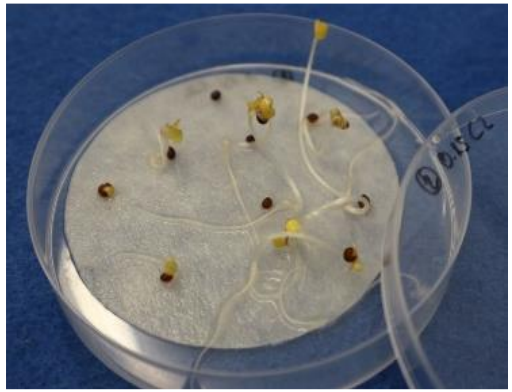
Salinity stress mitigation

High temperatures effect mitigation

Improve chlorophyll production

3. VALIDATION AND RESULTS

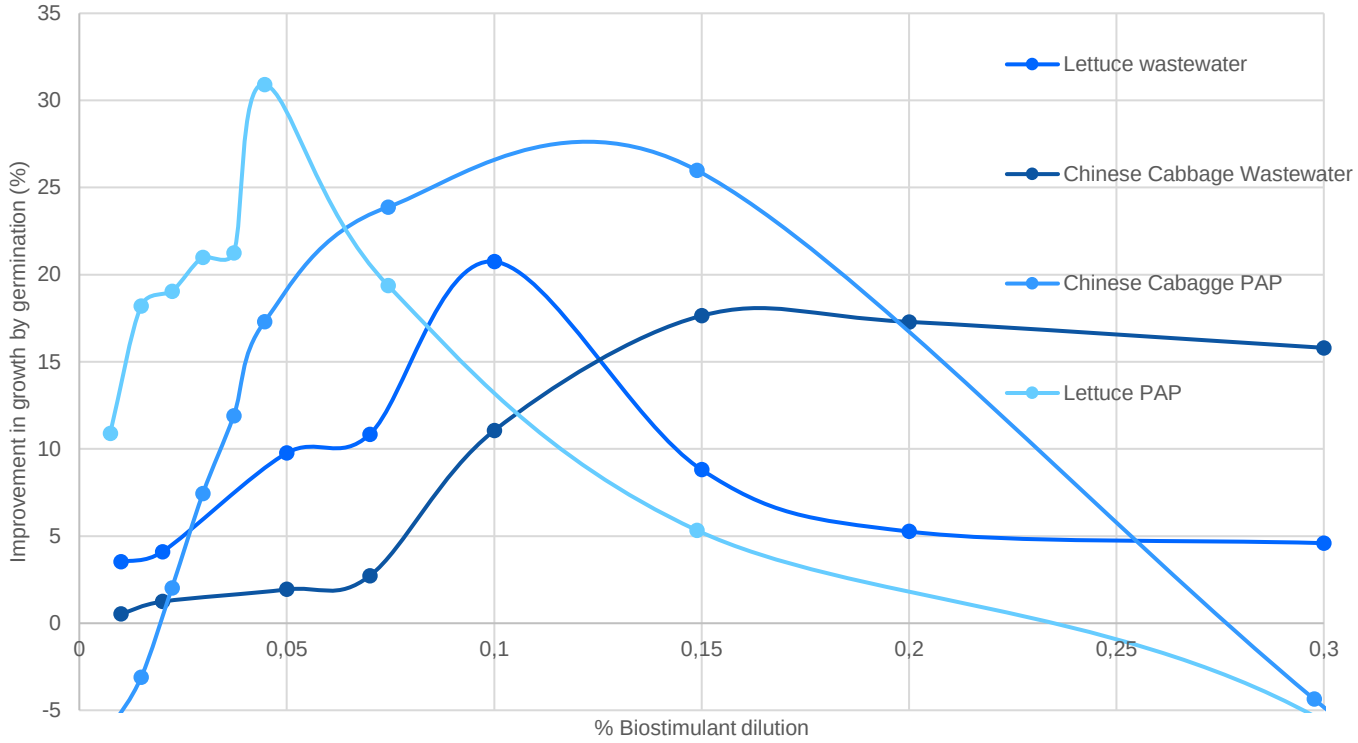
PROTEIN PRODUCT VALIDATION, IN VITRO GERMINATION BIOASSAYS

a)  b)  c) 

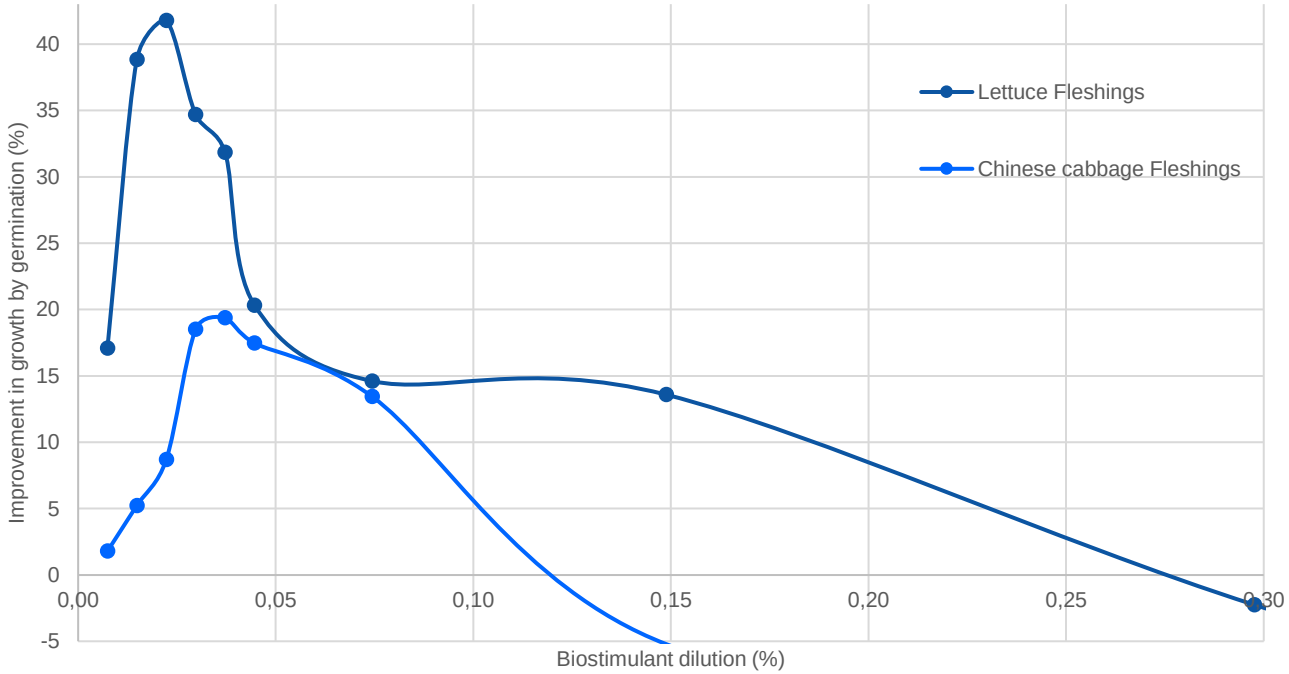
Study of the growth of Chinese cabbage and lettuce seeds by dosing different concentrations of biostimulant solution. Control sample of Chinese cabbage (a). Growth of Chinese cabbage using a dosage of 0.15 (b). Lettuce growth using a dosage of 0.15 (c). Source: own elaboration, INESCOP.

Seeds growth by 19-42% with the optimal biostimulant dilution concentration in the range of 0.05-0.2%. ISO standard 16086-2 2012.

VALIDATION OF HYDROLYSED PRODUCT FROM WASTEWATER AND PAP AS A BIOSTIMULANT



VALIDATION OF HYDROLYSED PRODUCT FROM LIME FLESHING AS A BIOSTIMULANT



4. CONCLUSION

CONCLUSION

- **High content of total amino acids** is observed in the range of **60-70 %**, with the results of the products corresponding to category 2 PAPs being higher than those of category 3 wastewater and fleshings.
- The products obtained show a noticeably **high protein recovery**, in the **range of 87-97%**, depending on the animal by-product used.
- The best germination growth results were obtained with a **low concentration** of hydrolysed protein (from fleshing) although the improvement in growth was not considerably higher than with PAP cat 2.
- Valorisation of these animal by-products to produce **biostimulants could be replicated and implemented in other waste management plants**.

BIOECONOMY CONTRIBUTIONS

Energy-efficiency

Enhancing the potential of **renewable energies, saving energy** and costs.

Optimising water consumption

Reduction of at least 96**% of water consumption** by industrial processes.

Reducing production and waste disposal costs, increasing the profitability of organic waste value creation by recovering up to 100 tonnes of protein per year.

Resource-efficient process

Reduction of 35% emissions in CO_2 and chemical substances, and wastewater reduction.

Intersectoral collaboration

For resource-efficient and high value applications of ABPs category 2 and 3.

Increased competitiveness

Opportunity for the tannery and rendering industry sectors to **close the loop and resource optimization.**

Introduce **new functionalised bioproducts** that will be able to meet current market demands on bio-based products in the agriculture industry.

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