Sustainable Chemistry and Agroecology

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Projects of public-private collaboration

FERTINAGRO BIOTECH

MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES

Financiado por la Unión Europea NextGenerationEU

Plan de Recuperación, Transformación y Resiliencia

AGENCIA ESTATAL DE INVESTIGACIÓN

LIGNOEFICIEN-P (CPP2021-008409): An innovative valorization of kraft lignins in sustainable fertilizers and biostimulants based on circular economy

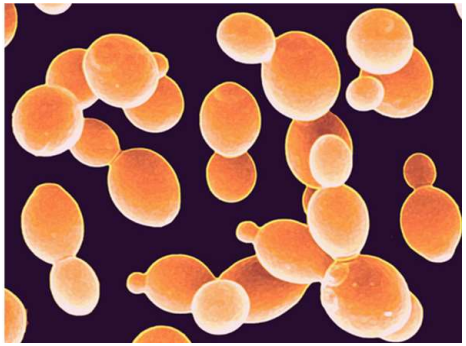
PORC-N-FREE (CPP2021-008476): Technological tools to close the economic loop in the swine sector and reduce its environmental impacts

BICOUREA (CPP2024-011474): New generation of nitrogenated fertilizers for an efficient and sustainable agriculture: urea co-crystals of slow nitrogen delivery with biostimulation

Objectives: PORC-N-FREE

Better fertilizers from liquid manure

Better circularity of nitrogen

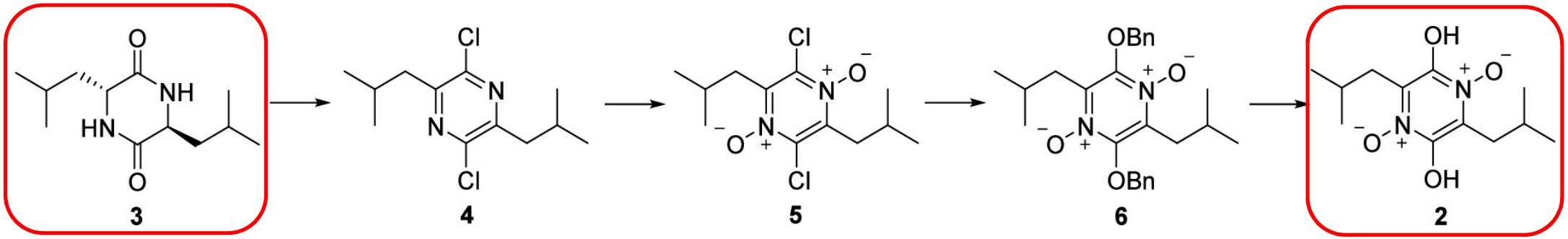


Metschikowia pulcherrima: natural extracts with inhibition activiy

NH_3

Identification and synthesis of the molecules responsible for the inhibition

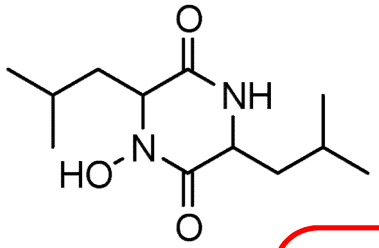
Pulcherriminic acid synthesis

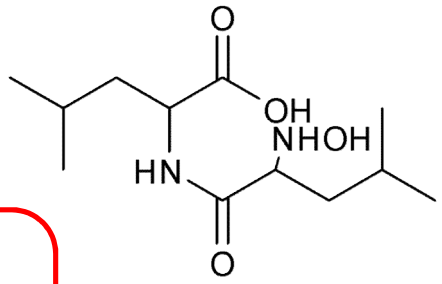


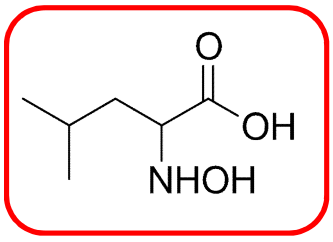
Present in extract
No inhibition

ACS Agric. Sci. Technol. **2024**, *4*, 405-413

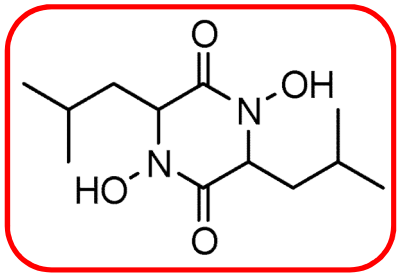
Absent in extract
No inhibition



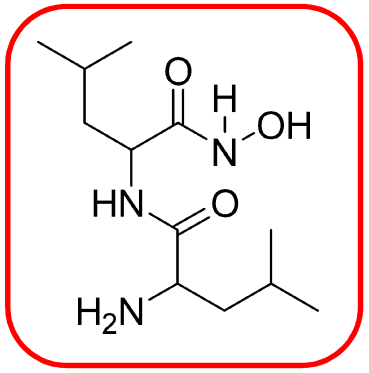




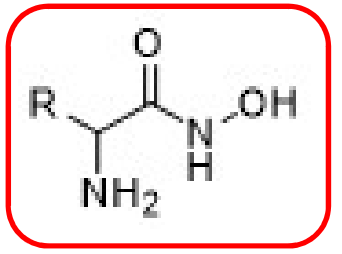
Absent in extract



Present in extract
No inhibition



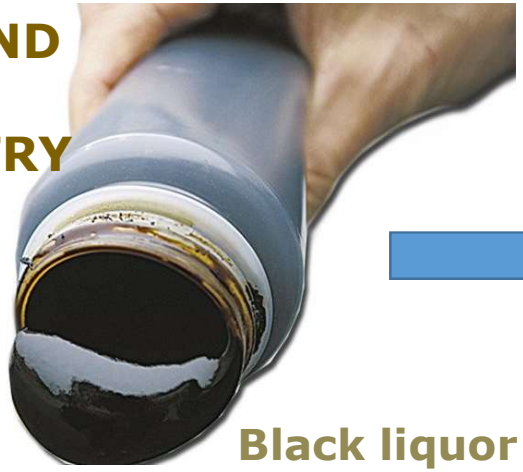
Absent in extract
No inhibition



Absent in extract
High inhibition

Objectives: LIGNOEFICIEN-P

PULP AND PAPER INDUSTRY



Black liquor

Kraft lignin

Zn and Mn

SPENT BATTERIES

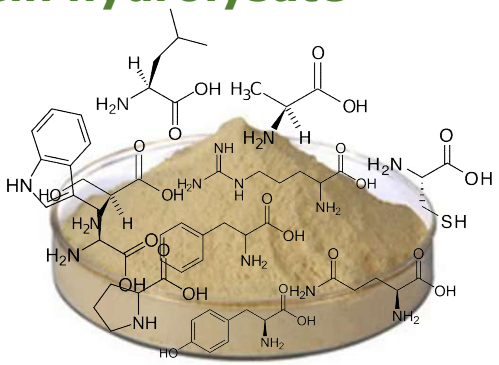
Black mass

COMPLEXED MICRONUTRIENTS FOR FERTILIZERS

SLAUGHTER HOUSE

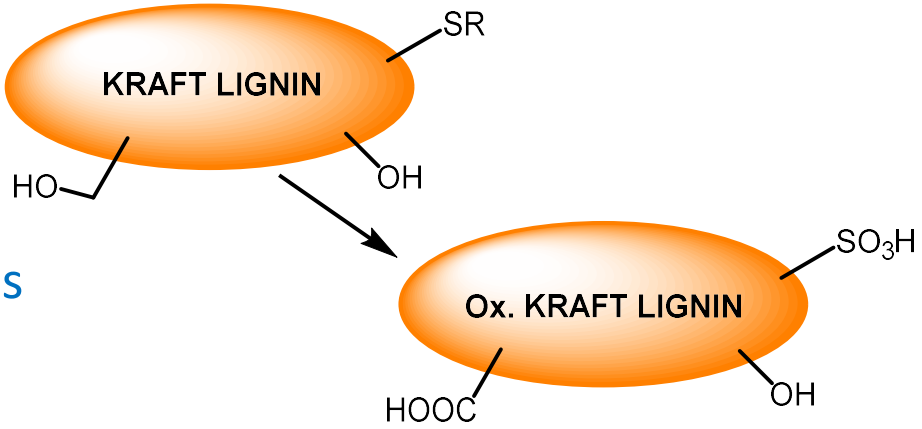
Blood

Protein hydrolysate

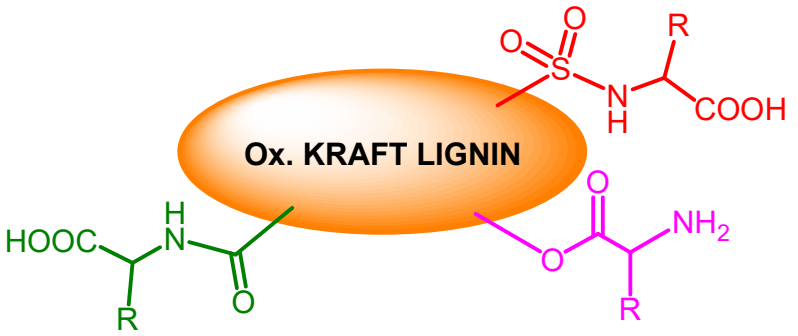


Objectives: LIGNOEFICIEN-P

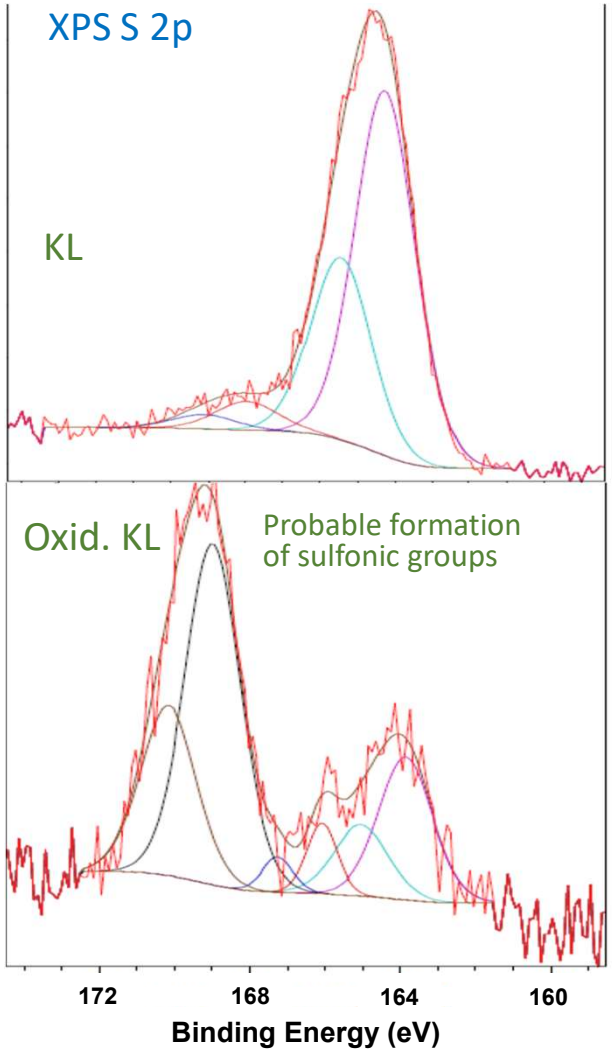
- ✓ Oxidation of kraft lignin:
  - Generation of sufonic groups
  - Increase in the content of carboxylic groups



- ✓ Reaction with amino acids:
  - Formation of **lignosulfonyl amides**
  - Formation of **lignocarboxamides**
  - Formation of **lignoyl amino esters**



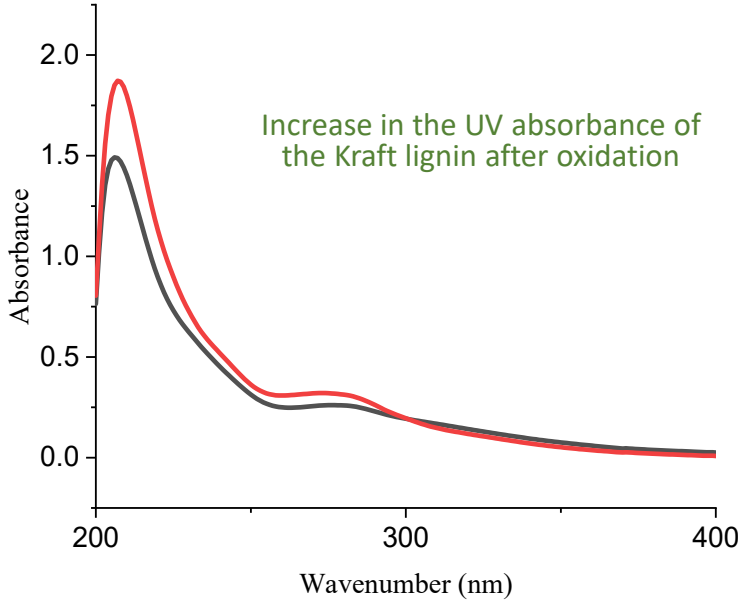
Oxidation of Kraft lignin



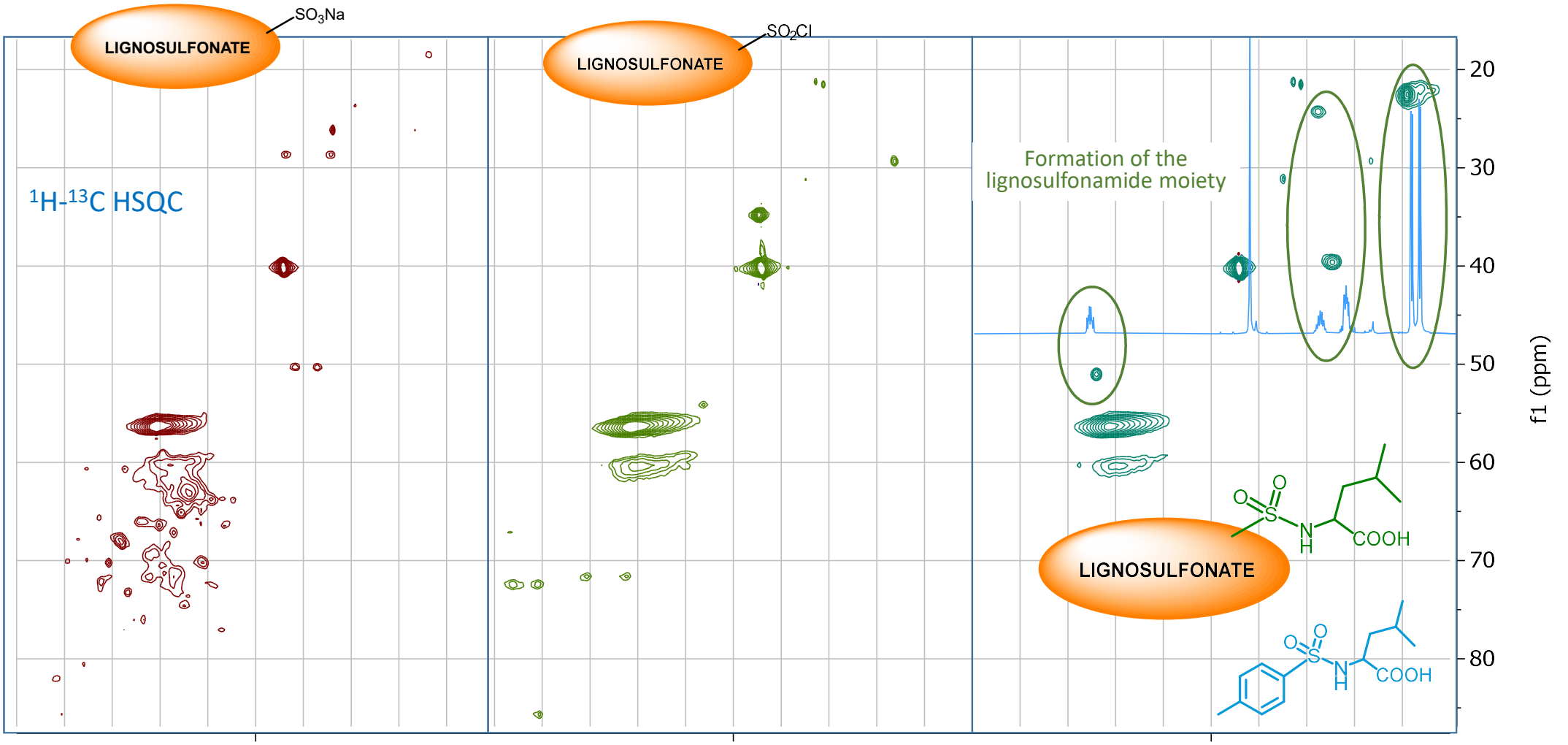
^{31}P NMR

	Aliphatic	Phenols	COOH
KL	0.81	4.78	0.40
KL-EtOAc	0.40	4.80	0.41
oxidized	0.37	**4.03**	**0.89**
		Quinones?	Aldehyde oxidation

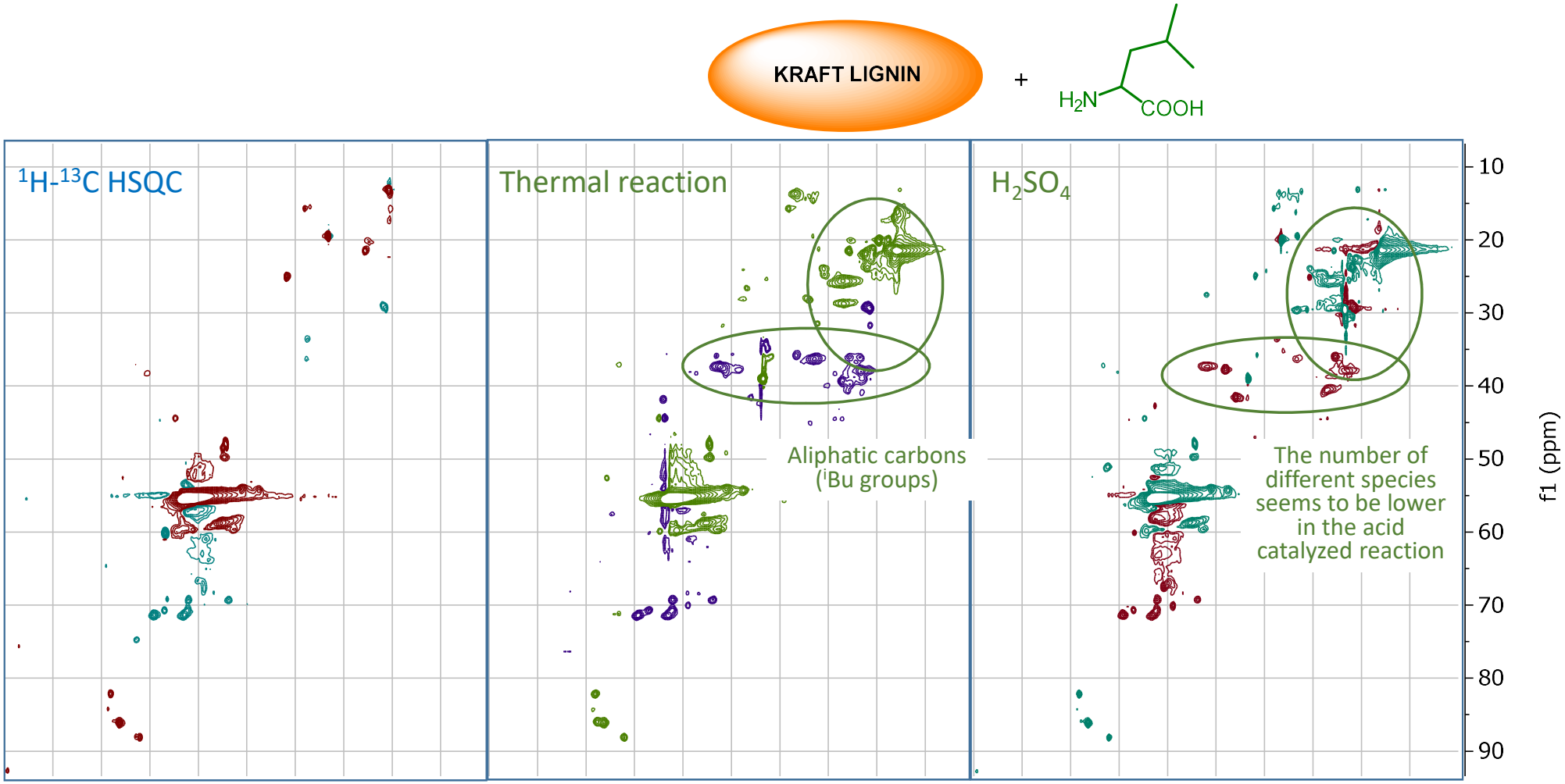
Lignosulfonates are already used as complexating agents in fertilizers



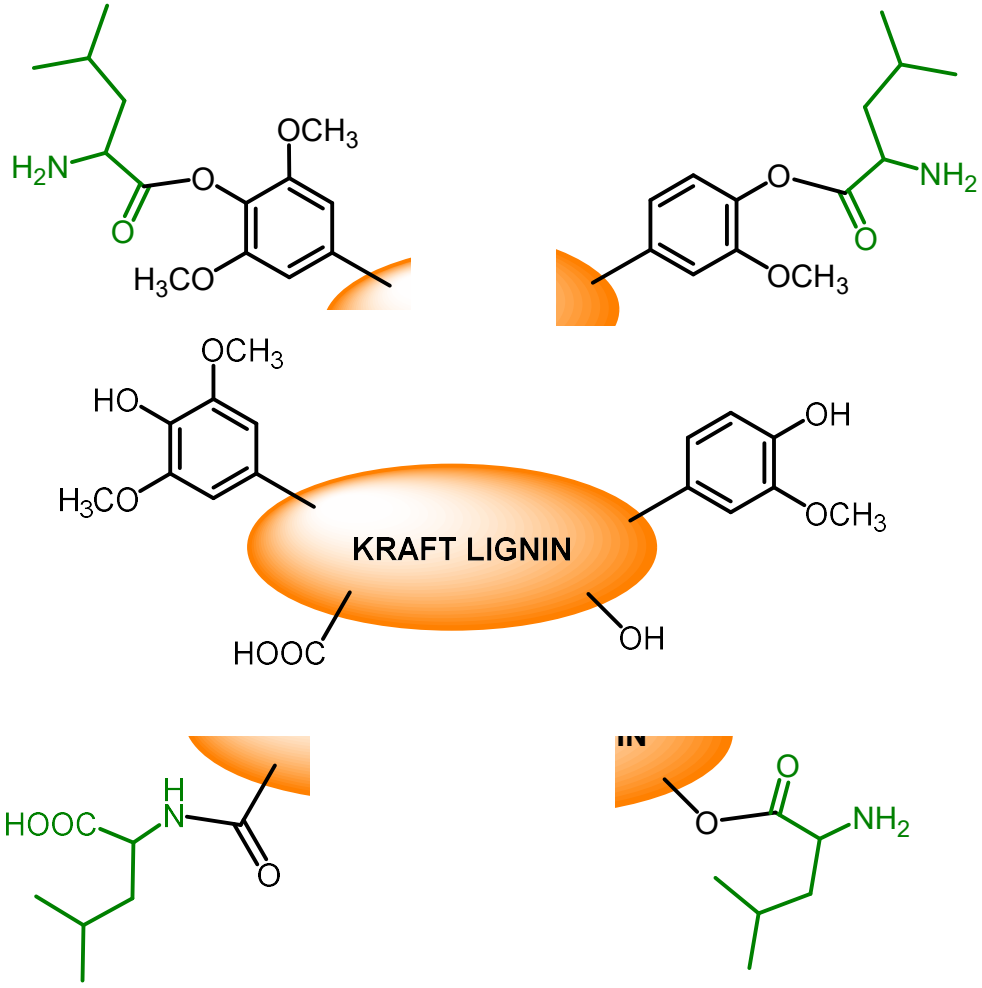
Reaction of lignosulfonate with amino acids



Reaction of Kraft lignin with amino acids



Reaction with amino acids



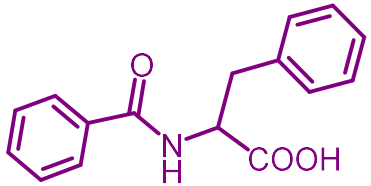
Elemental Analysis

	C	H	N	S
KL	61.30	5.57	-	3.52
KL-Leu-85	63.91	5.91	0.54	3.39
KL-Leu-120	65.80	6.65	**1.59**	3.51
KL-Leu-H-85	63.55	6.15	0.81	**4.04**
KL-Leu-H-120	65.11	6.96	**2.08**	**4.17**

1.1-1.5 mmol/g of amino acid incorporated

Reaction with DMSO and sulfuric acid?

KL-N-Bz-Phe-120	62.77	6.69	**0.85**	3.47



Only 0.6 mmol/g of amino acid with protected amino group

Optimization in the use of ureic nitrogen in fertilizers

- ✓ Formation of urea co-crystals for controlled urea delivery in soil:
  - With other nutrients (phosphate, sulphate…)
  - With micronutrients (Fe, Cu, Zn, Mn…)
- ✓ Development of biostimulants from protein hydrolysates:
  - Identification of the species responsible for biostimulation
  - Improvement of the preparation of biostimulants
  - Incorporation of biostimulants to urea co-crystals

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