AGRICULTURAL VALORIZATION OF SEAWEED FROM THE SHORES OF MAR MENOR LAGOON BY COMPOSTING

Universidad Autónoma de Madrid

C. García-Delgado[1],V. Polo[1], B. Mayans[2], M. A. Jiménez-González[1], T. Fresno[2], E. Eymar[2], Sandra López-Rayo[2]

[1]*Department of Geology and Geochemistry, Faculty of Sciences, University Autónoma of Madrid, 28049-Madrid, Spain* carlos.garciadelgado@uam.es

[2]*Department of Agricultural Chemistry and Food Science, Faculty of Sciences, University Autónoma of Madrid, 28049-Madrid, Spain*

INTRODUCTION

The **Mar Menor Lagoon** is a coastal saline lagoon located in the Region of Murcia, in southeastern Spain. It is the largest saline lagoon in Europe and is separated from the Mediterranean Sea by a strip of land known as La Manga. Over the years, the Mar Menor Lagoon has faced various environmental problems, such as seaweed proliferation and eutrophication, due to intensive agricultural activity, urbanization, and lack of adequate water renewal. The **seaweed *Caulerpa prolifera*** is a green alga characteristic of the Mediterranean Sea which entered the lagoon after the dredging and widening of the Estacion channel in the 70´s, causing an alteration in this ecosystem. Currently, recurrent episodes of **bloom explosions** of this seaweed are produced by the **eutrophication of the lagoon** and the favorable environmental conditions.

Detail of the Mar Menor lagoon and the surrounding area

ALGARIKON
Hongos cultivados con arribazones de algas del Mar Menor

ALGARIKON is a coordinated Spanish project focused on the Valorisation of the algae accumulated on Mar Menor shores as a result of its eutrophication.

OBJECTIVE

To evaluate the composting process of seaweed waste accumulated on the shore of the Mar Menor lagoon for its subsequent valorization as an agricultural amendment.

MATERIALS AND METHODS

Aspect of the seaweed (*C. prolifera*) and urban pruning

Table 1: Basic characterization of Seaweed and urban pruning

	OM (%)	C (%)	N (%)	C/N	pH (H_2O)	CE (µS/cm)
Seaweed	62 ± 2	32.25 ± 0.01	3.18 ± 0.03	10.1 ± 0.1	6.73 ± 0.08	30.37 ± 0.93
Urban pruning	90.3 ± 0.8	40.79 ± 0.57	1.02 ± 0.17	40.2 ± 0.8	6.93 ± 0.03	2.59 ± 0.15

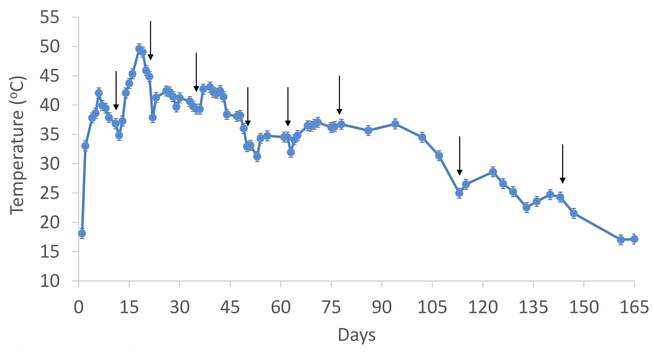
❑ Analytical procedures

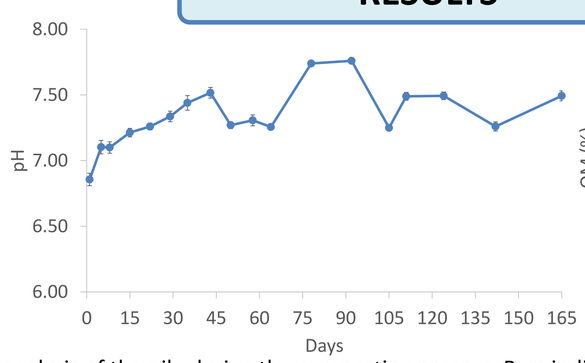
- Temperature at 30 cm
- Moisture at 105 ºC
- Organic Matter (OM) by loss-on-ignition test: 5g, 550 ºC, 5h
- pH, electrical conductivity (EC), Cl^- and NO_3^- in extract 1:10 (w:v)
- Total C and N by elemental analysis
- Carbon characterization
  - FT-IR
  - CP-MAS ^{13}C-NMR analysis

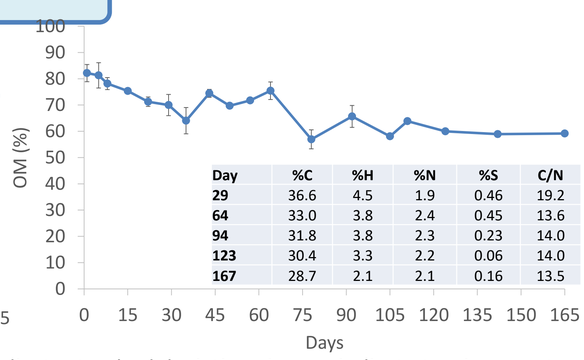
❑ Composting conditions:

- Windrow pile
- Seaweed : Urban pruning 1:2 (w:w)
- Long 5 m, wide 1.5 m, high 0.7 m
- Initial C/N ~ 30
- Moisture 50 – 60%
- Aeration by periodical turning and natural convection
- Duration 167 days (May – October 2023)

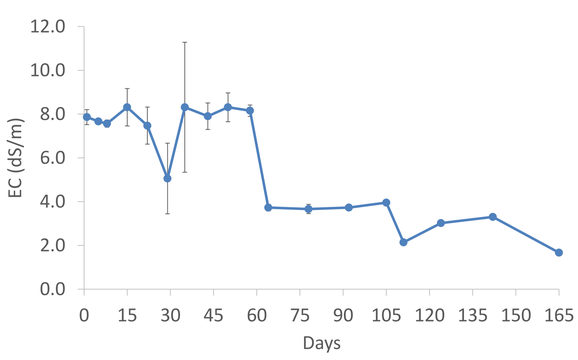
RESULTS



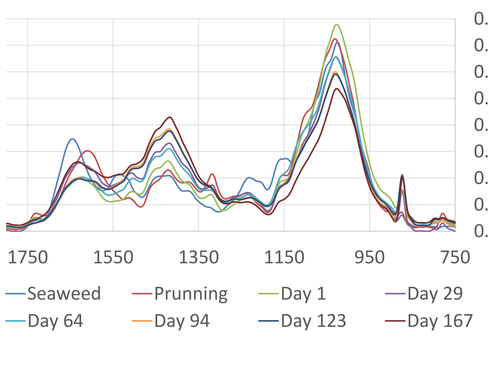


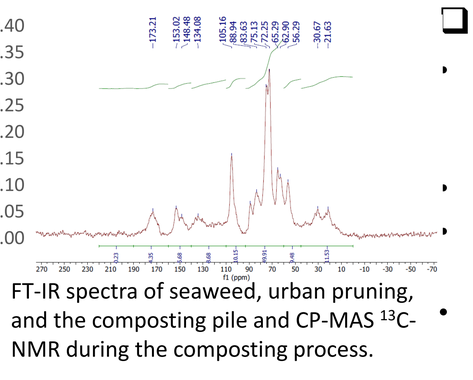


Day	%C	%H	%N	%S	C/N
29	36.6	4.5	1.9	0.46	19.2
64	33.0	3.8	2.4	0.45	13.6
94	31.8	3.8	2.3	0.23	14.0
123	30.4	3.3	2.2	0.06	14.0
167	28.7	2.1	2.1	0.16	13.5



Evolution of temperature, pH, organic matter content and elemental analysis of the pile during the composting process. Bars indicate standard deviation. Arrows indicate turning events.





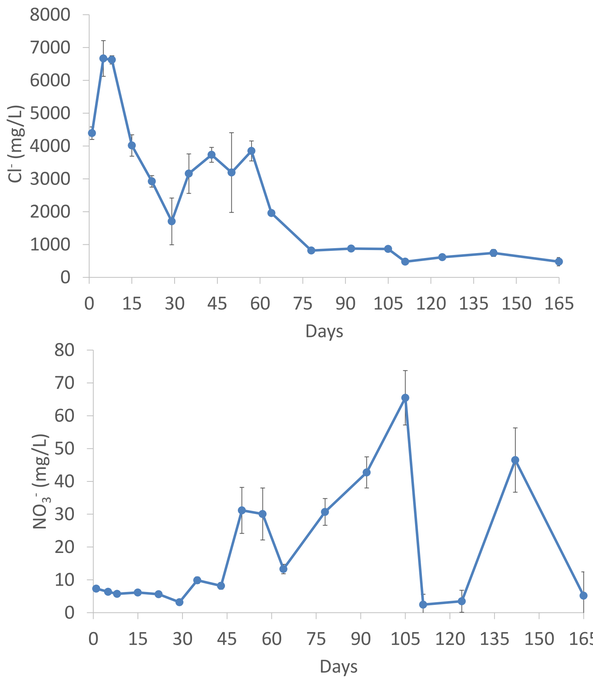
FT-IR spectra of seaweed, urban pruning, and the composting pile and CP-MAS ^{13}C-NMR during the composting process.

Relative areas (percentage of total area) of the chemical shift regions in CP-MAS ^{13}C-NMR of seaweed, urban pruning, and the composting pile.

Chemical shift (ppm)	Type of bond	Seaweed	Urban prunning	Day 1	Day 29	Day 64	Day 94	Day 123	Day 167
					% total area				
0 - 45	Alkyl	20.6	7.5	7.0	5.6	12.2	11.66	13.07	11.53
45 - 60	N-alkyl	6.9	4.3	6.3	7.2	8.2	12.17	5.81	9.48
60 - 93	O-alkyl	45.7	63.1	63.6	68.2	47.7	45.6	47.43	49.91
93 - 110	Di-O-alkyl	10.7	15.0	13.2	10.0	10.5	10.34	11.25	10.15
110 - 140	Aromatic	5.4	0.2	2.4	2.2	7.11	6.42	8.85	8.68
140 - 160	Phenolic	1.7	3.5	2.0	2.9	4.5	5.32	5.69	5.68
160 - 190	Carboxyl	7.2	6.1	5.1	3.7	8.6	7.54	7.85	4.35
190 - 220	Carbonyl	1.8	0.3	0.4	0.3	1.26	0.94	0.05	0.23

❑ Main findings:

- The temperature increased quickly from 18 ºC to 33 ºC on day 2. The maximum temperature of 49.6 ºC was achieved on day 18. The temperature above 30 ºC remained until day 113 denoting a long composting process.
- The pH of the compost increased from 6.86 ± 0.05 to 7.49 ± 0.04.
- The total C content decreased during the composting process to reach a final value of 28.7 ± 0.7 %.
- No decrease in total N was observed during the composting process. The final value of total N was 2.1 ± 0.3 % denoting the high potential of the compost as N source.
- The EC decrease from 7.86 ± 0.34 dS/m to 1.67 ± 0.10 dS/m.
- The chloride content of the compost decreased during the process from 4400 mg/L to 405 ± 19 mg/L.
- The spectroscopic analysis showed the evolution of the organic matter during the composting process. The most important modification was taken out during the second month of composting when the O-alkyl groups, related to carbohydrates, decreased drastically and the aromaticity increased.
- The matureness of the final compost was demonstrated by the low temperature of the pile at the end of the process and the C/N of 13.46 ± 0.83.



Evolution of EC, Cl^-, and NO_3^- of the pile during the composting process. Bars indicate standard deviation.

CONCLUSIONS

The composting of seaweed of the Mar Menor Lagoon with pruning waste is an effective procedure to recycle an organic waste that produces important economic and environmental problems. The final compost is a stable material with valuable nitrogen content and adequate characteristics to be used in agriculture.

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