Characterization of Carbon Dot-reinforced biocompatible films for the active protection against the oxidation of oils

X NyNA 2022
INTERNATIONAL CONGRESS ON ANALYTICAL NANOSCIENCE AND NANOTECHNOLOGY
Castilla – La Mancha (Ciudad Real)
6-8 September 2022

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Introduction

What? We developed new **active materials for containers (AMC)** trying to Improve their antioxidant capabilities, particularly against the oxidation of edible and cosmetic oils.

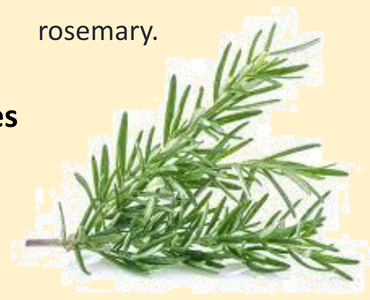
Why? Because oxidation is one of the main deterioration causes of oil-based materials, present in the food industry and also in cosmetics or lubrication. **Oil oxidation constitutes a huge economic problem** for Industry.

How? Exploiting the **antioxidant properties of Carbon Dots**, which are well-known green and sustainable active additives obtainable from natural carbon sources. We immobilize carbon dots within the stable biopolymeric base matrix constituted by caseinate (CAS) and highly methoxylated pectin HMP.

Synthesis and characterization of CDs

apple pomace

rosemary.

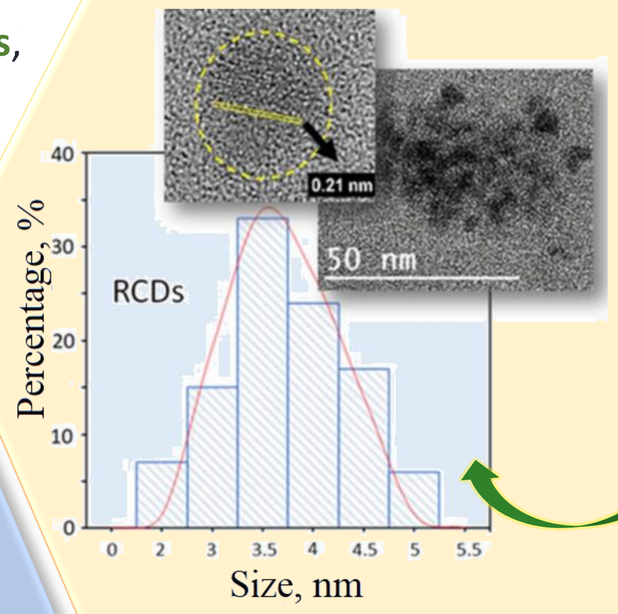


Natural carbon sourcces
+ water

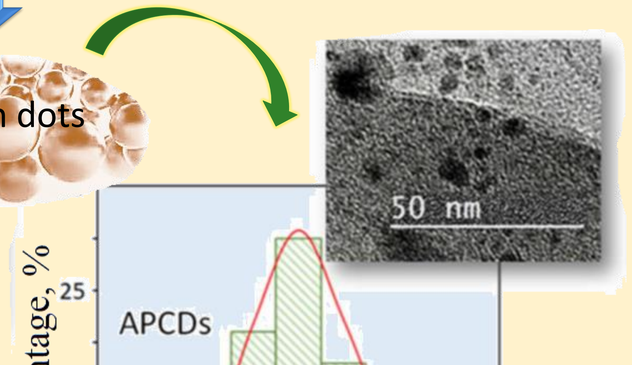
Hydrothermal

oven for 5 h at 200 °C

source	Acronym CD
Apple pomace	APCD
Rosemary	RCDs



Carbon dots

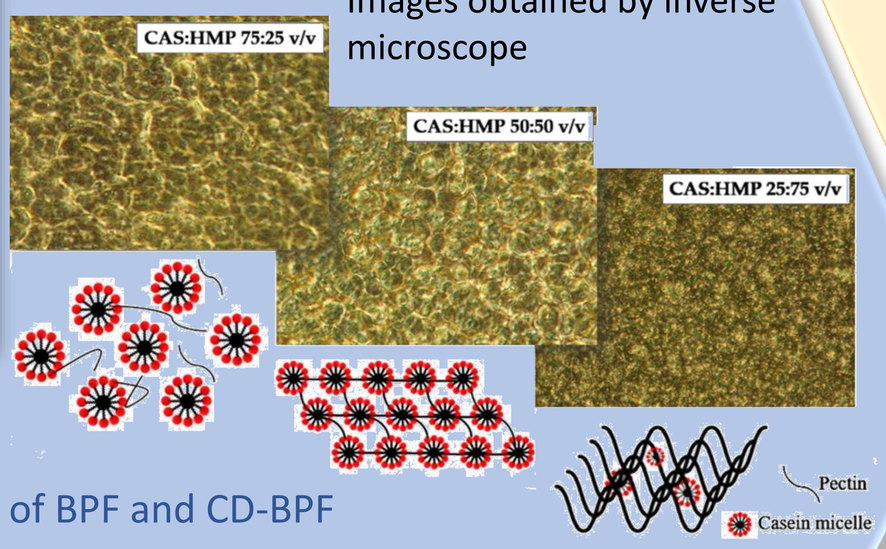


Size histograms of RCDs and APCDs and HR-TEM images.

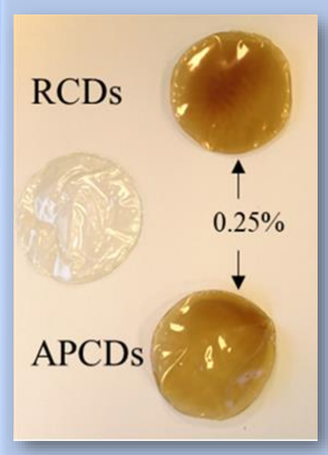
Synthesis and characterization of bio-polymer-based films (BPF) reinforced Carbon Dots

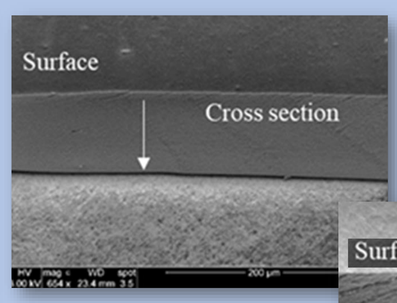
CAS:HMP dispersions

Images obtained by inverse microscope

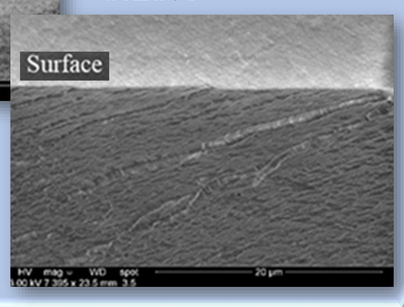


The appearance of BPF and CD-BPF





Magnifications 200 µm



Magnification 20 µm

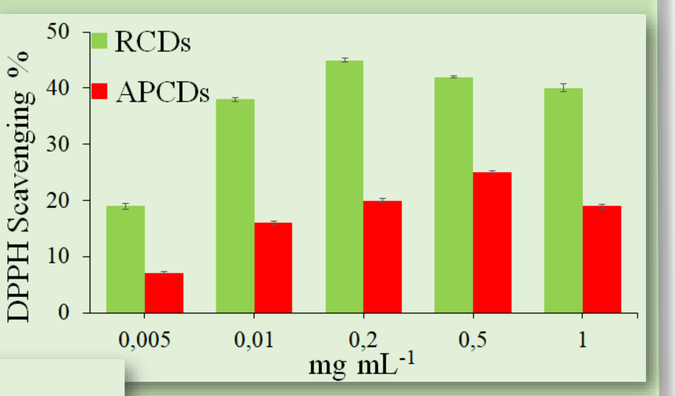
SEM images of a CAS/HMP (25:75) biofilm containing 0.25%

CD-BPFs

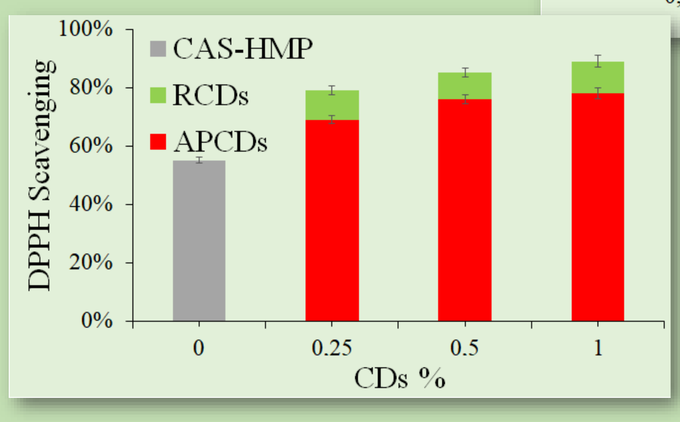
Antioxidant activity

DPPH assay

The presence of an odd electron in the nitrogen atom of DPPH• allows its reduction by receiving an electron or hydrogen radical changing from deep violet colour to a decolourization solution.



RCDs and APCDs



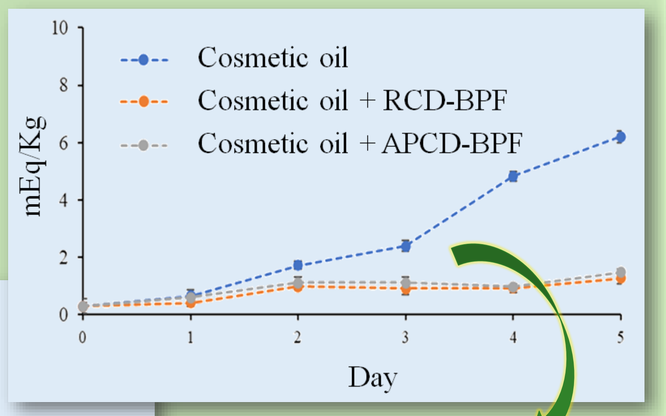
$$\%\ \mathrm{DPPH}_{\mathrm{inhibition}} = \left(1 - \frac{A_s}{A_b}\right).100$$

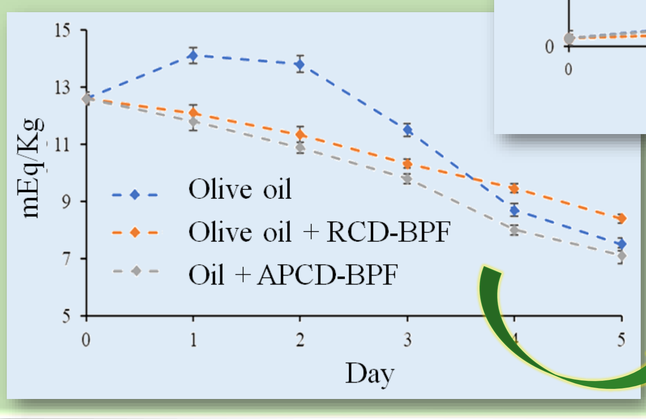
A_b : the absorbance of the control
A_s : the absorbance of the sample

Determination of the Lubricant Oil Peroxide Value

$$PV = \frac{(V - V_0).C_t.1000}{w}$$

V and V_0: volumes of the sodium thiosulfate standard solution at equivalence point for sample and blank solution.





Conclusions

- The CD- BPF had a manageable structure and a compact appearance and the results prove that green CDs favourably modify the thermal stability.
- Green carbon dots have been used as additives for the fabrication of active CAS-HMP bio-polymer based films, BPF-CDs.
- Both types of CDs have intrinsic antioxidant properties, being the RCDs the ones with the highest antioxidant activity against the radical DPPH •.
- CAS / HMP films also show antioxidant activity (due to casein), which increases with the addition of CDs.
- It was possible to demonstrate by determining the peroxide value, that CD-BPF decrease the oxidation process of edible and cosmetic oils.

Acknowledgments

Financial support from: *Principado de Asturias* (FICYT IDI/2021/000276), MCIU/AEI/FEDER, UE (RTI2018-099756-B-I00). Sandra Rodríguez-Varillas. also thanks the Administration of the *Principado de Asturias* for the grant of a *Severo Ochoa* fellowship.