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Effect of gamma irradiation on cellulose-based materials

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PURPOSE

Obtain new materials with antimicrobial and antioxidant properties

Grafting cellulose/chitin (CC) mix substrate with Eugenol (Eu), Grape seeds oil (GO) and Rosehip seeds oil (RO) - using a two steps process

I) Activation of the substrate by gamma irradiation

II) Reaction with different modifiers by subsequent coupling reaction

Activation procedure

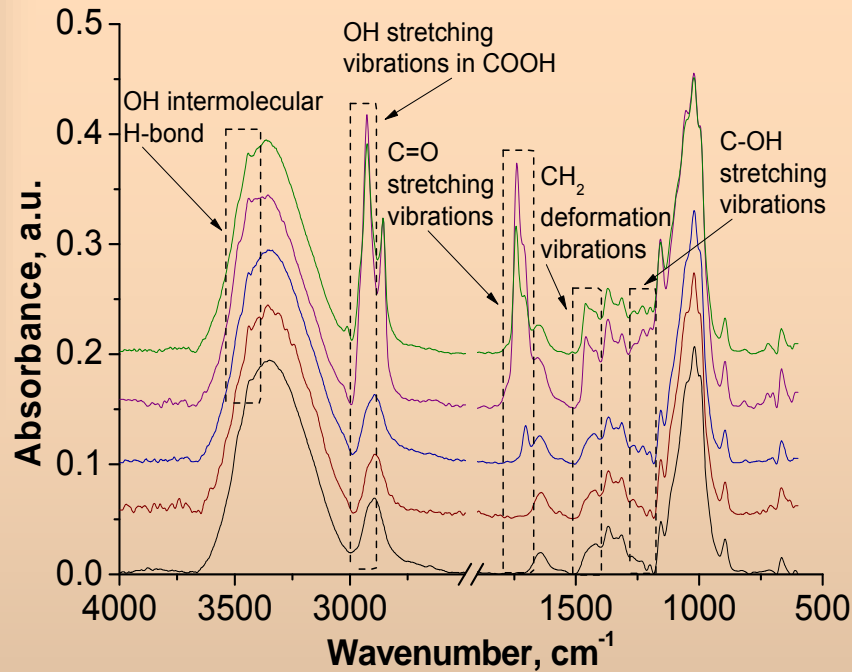
The exposure on radiochemical processing:

- *γ -irradiator M-38 GAMMATOR (USA)*
- *air at room temperature*
- *^{137}Cs source*
- *dose rate : 0.4 kGy/h*

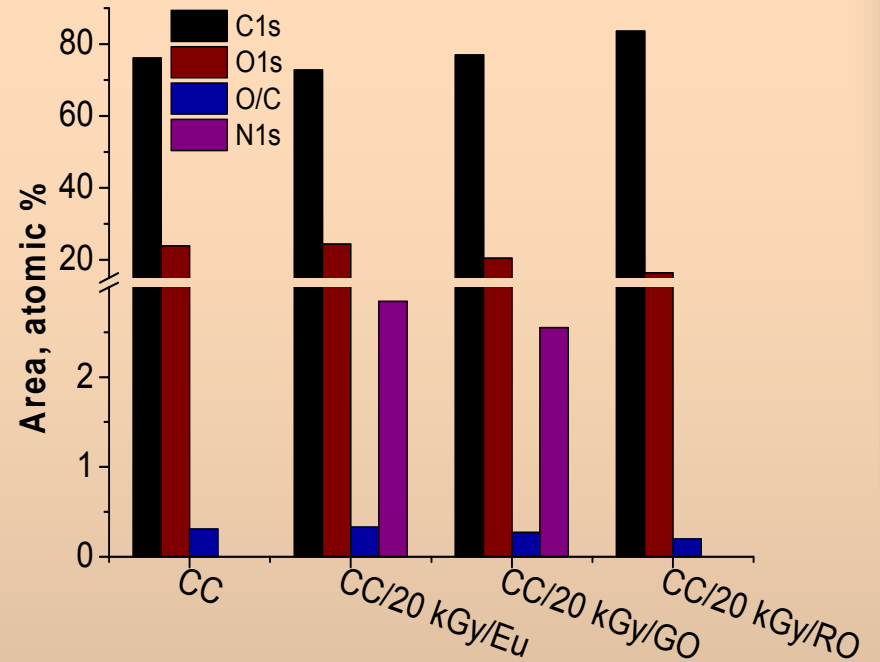
Modification procedure

- After activation, the cellulosic substrate was immersed in the treatment methanol solutions (10 wt%) of Eu and chloroform solutions (10 wt%) GO and RO for 60 minutes, on mechanic stirring.
- The solutions used contain two chemical coupling agents: 1-(3-dimethylaminopropyl)-3-ethylcarbodiimide (**EDC**), used as a carboxyl group activator for the coupling of primary amines to yield amide bonds; and N-hydroxysuccinimide (**NHS**) was used to increase coupling efficiency and create a stable amine-reactive product.
- The modified cellulosic substrates were then dried at 60 °C, and after that extracted for 25 h in a Soxhlet extractor with methanol and chloroform respectively, in order to remove the physically adsorbed unreacted chemicals.
- The modified cellulosic substrates (CC/Eu, CC/GO and CC/RO) were dried and analyzed.

Surface properties



Normalized ATR-FTIR spectra of the untreated CC substrate (●), CC/20 kGy (●), CC/20 kGy/Eu (●), CC/20 kGy/GO (●) and CC/20 kGy/RO (●)



XPS - Relative concentration of C1s peak for untreated and gamma irradiated samples

- The modification/grafting degree estimated from XPS data was 31.1 % for CC/20 kGy/Eu, 55.0 % for CC/20 kGy/GO and 58.7 % for CC/20 kGy/RO.

Antimicrobial and antioxidant activity

Antimicrobial activity and radical scavenging activity (RSA) of untreated and gamma irradiated and further modified samples

<i>Sample</i>	<i>Escherichia coli</i>	<i>Listeria monocytogenes</i>	<i>Salmonella enteritidis</i>	<i>RSA (%)</i>
<i>CC</i>	<i>32</i>	<i>44</i>	<i>36</i>	<i>0</i>
<i>CC/20 kGy/Eu</i>	<i>72</i>	<i>87</i>	<i>100</i>	<i>100</i>
<i>CC/20 kGy/GO</i>	<i>82</i>	<i>100</i>	<i>97</i>	<i>49.6</i>
<i>CC/20 kGy/RO</i>	<i>64</i>	<i>100</i>	<i>100</i>	<i>100</i>

Conclusions

- *Cellulosic substrate has been modified with eugenol, grape seeds oil and rosehip seeds oil, using gamma irradiation for the activation.*
- *The modification/grafting degree estimated from XPS data was between 31.1 and 58.7%.*
- *The antimicrobial activity and antioxidant activity was imparted.*
- *Such treatment could find applications in food packaging, wound-dressing materials, dialysis membranes, drug delivery carriers, etc.*

*For more information, please
come see the poster!*

Thank you!

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