Polyphenols as antiviral agents onto NWF of face masks: a proof of concept

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Abstract

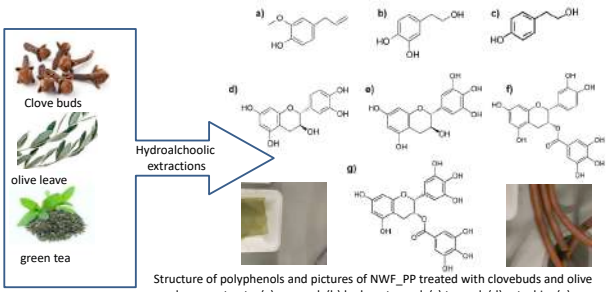
The pandemic situation caused by the SARS CoV2 that we are still experiencing has highlighted that the use of disposable face masks can effectively mitigate the spreading of respiratory virus. At the same time, several works recently published, raised some doubts about the real effectiveness of these devices in filtering SARS CoV2 during coughs by infected patients.[1] The mask is often worn incorrectly and frequently touched, increasing the risk of contamination of the user's hands and of surfaces.

In this scenario, we thought to use polyphenolic compounds, which are characterized by well-known antiviral properties [2-5], as coating agents of the external surface of surgical masks. Indeed, their application onto the non-woven fabric (NWF) of masks could limit the infection circulation, by reducing the cross-contamination of patients and health care workers. In this context, our work aimed at improving the barrier effect of disposable face masks by depositing on their external surface a mixture of bioactive compounds, mainly polyphenols, extracted from agronomical sources [6].

Clove buds, olive leaves, and green tea were treated with hydroalcoholic solutions and the extracts applied onto the non-woven polypropylene fabric (NWF_PP) of face mask. Each extract and each NWF_PP treated with the extracts were characterized from the chemical, structural and thermal point of view by focusing, in particular, to antioxidant, antibacterial and antiviral properties of covered surfaces. The presence of active polyphenols in the extracts and onto the NWF_PP surfaces was highlighted by ATR-IR spectroscopy and their content in the extracts determined by reversed phase HPLC. Thermogravimetric analysis and OIT/OOT measurements allowed the quantification of polyphenols deposited onto the NWF_PP surfaces and evidenced the improved stability of treated face mask to oxidation [6]. The antibacterial and antiviral properties were evaluated by experimental tests towards NDM-producing *Klebsiella pneumoniae* and two respiratory transmitted viruses (Human Adenovirus type 5-HAdV5 and Human Coronavirus 229E-HCoV229E).

Finally, to improve the coating and thus the chemical interactions between the polyphenols and the mask surfaces, the NWF_PP was activated by cold plasma treatment (under oxygen) in different conditions and UV irradiation (by using a photoiniziator). The presence of different functionalities was evidenced by ATR-IR spectroscopy. The activated-NWF_PP surfaces were treated with the extracts and characterized by ATR-IR and TGA. Preliminary tests concerning the migration and stability of antiviral ingredients were thus carried out.

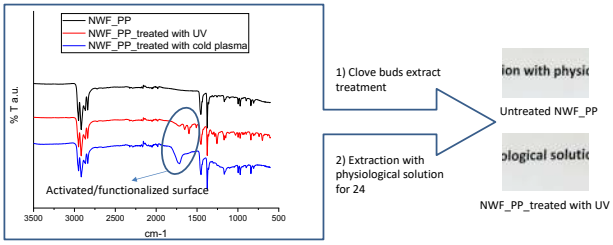
Preparation and characterization of NWF_PP with antiviral activity



Structure of polyphenols and pictures of NWF_PP treated with clovebuds and olive leaves extracts; (a) eugenol, (b) hydroxytyrosol, (c) tyrosol, (d) catechin, (e) epigallocatechin, (f) epicatechin-3-gallate, (g) (-)-epigallocatechin-3-gallate (EPCG).

	Initial virus titer	Titer after test ($TCID_{50}$ ± SD)	Log10 Reduction	Percentage Reduction
Clove buds extract				
HAdV5	$5.40x10^4 \pm 1.60x10^4$	$2.33x10^3 \pm 2.10x10^3$	1.36	95.60 %
HuCoV229E	$7.77x10^3 \pm 6.61x10^3$	$5.27x10^3 \pm 0.91x10^3$	0.16	32.2 %
Olive leaves extract				
HAdV5	$5.40X10^4 \pm 1.60x10^4$	$4.58\ X10^3 \pm 3.33x10^3$	1.07	91.50%
HuCoV229E	$7.77X10^3 \pm 6.61x10^3$	$8.43X10^2 \pm 0$	0.96	89.15%

Results of virucidal tests performed on HAdV5 and HuCoV229E using clove bud and olive leave extracts.



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