DEVELOPMENT AND CYTOTOXICITY OF NOVEL SILANE-MODIFIED CLAYS INTENDED TO A NANOCOMPOSITE MATERIAL FOR THE FOOD INDUSTRY

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Abstract: Polymeric materials have traditionally been filled with natural or synthetic compounds to improve their properties, such as barrier, mechanical and thermal properties. The characteristics of particle-reinforced polymeric composites are strongly influenced by the dimensions and structure of the dispersed phase. Nowadays, the incorporation of silane-modified clays is a great alternative, obtaining novel nanocomposite materials with better technological profiles in comparison twith the raw polymers. Several authors have evaluated the modification and safety of different clays [1,2, 3]. The Technological Institute of Packaging, Transport and Logistic has developed two novel silane-modified clays, Clay3 and Clay4, intended to be incorporated to polypropylene (PP) for their use in the food packaging area. The incorporation of the silane-modifiers to montmorillonite has been evaluated through different methods [4], and compared with the unmodified clay (Fig.1). Interlayer space have been enlarged with the silane modification in clay 3. Results of interlayer space are shown in Table 1. It can be observed that the interlayer space in clay3 is twice of the raw clay (N116). This is an important step to reach a good exfoliation in the final nanocomposite.

Moreover, taking in account their use as food contact material, their safety to consumers should be evaluated. In this regard, a preliminary toxicity study has been performed by means of different cell viability biomarkers. The human liver HepG2 cell line was selected as target of toxic substances absorbed by oral exposure. Cells were exposed to concentrations between 0 and 250µg/mL of Clay3 and Clay4, determining total protein content (PC) and MTS tetrazolium salt reduction (MTS). Clay3 did not show toxicity in the range of concentrations tested in both biomarkers (Fig. 3). However, HepG2 exposed to Clay4 presented significant differences in the PC in all times of exposure considered (Fig. 4). In conclusion, novel silane-modified clays with improved properties have been obtained, but their safety should be further studied previously to their commercial use.

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References

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Figures

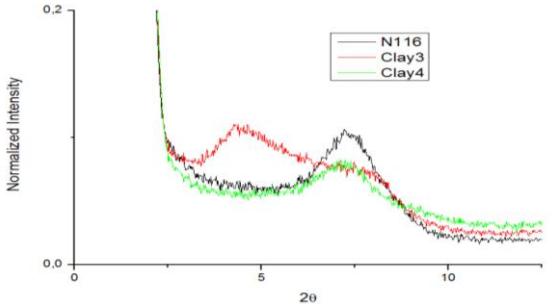

Figure 1. X-ray spectrum of raw clay N116, and organosilane-modified clays (Clay3 and Clay4).

Muestra	2θ	d_{001} (Å)
N116	8.85	9.99
Clay3	7.29 4.70	12.13 18.80
Clay4	7.17	12.33

Table 1. Interlayer space results of raw clay N116, and organosilane-modified clays (Clay3 and Clay4).

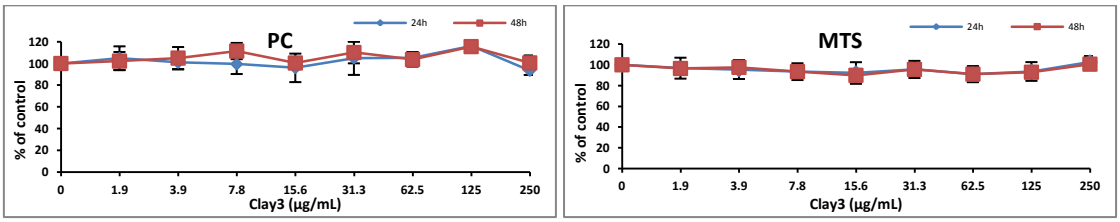

Figure 3. Protein content, PC (a) and reduction of tetrazolium salt, MTS (b) of HepG2 cells after 24 h and 48 h of exposure to 0–250 µg/mL Clay3. All values are expressed as mean ± SD.

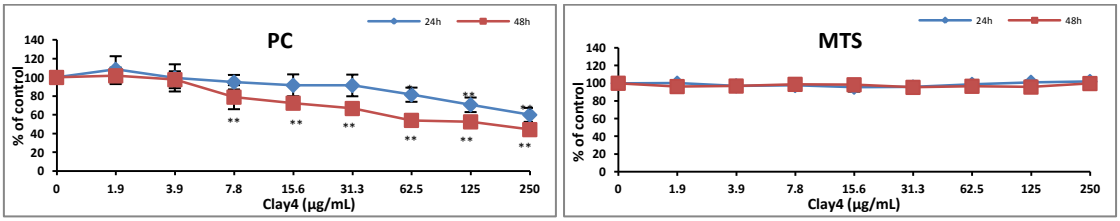

Figure 4. Protein content, PC (a) and reduction of tetrazolium salt, MTS (b) of HepG2 cells after 24 h and 48 h of exposure to 0–250 µg/mL Clay4. All values are expressed as mean ± SD. $^{*}p$<0.05 and $^{**}p$< 0.01 significant and very significant different from control, respectively.