**Preparation of UV-curable biodegradable functionalized polyesters**

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**Highlights**

* Photocrosslinkable biodegradable copolymers were developed based on unsaturated polyesters;
* Photocrosslinking was achieved with a UV exposure time of 2.5 minutes;
* Flexible materials at room and physiological temperatures were obtained;
* According to the obtained results, the materials are suitable for biomedical applications.

**1. Introduction**

Traditional methods of wound closure are suturing and stapling, but they are associated with pain, wound infection and low aesthetic results. As a result of these shortcomings, medical tissue adhesives are considered an attractive alternative since, besides wound closure, they can accomplish other tasks, such as haemostasis and the ability of sealing air leakages [1,2]. The most used surgical glues nowadays are the fibrin based adhesives [3] and cyanoacrylates [4]. Fibrin based adhesives present several problems, e.g. immunogenicity and risk of blood transmission diseases such as HIV and BSE [3]. Cyanoacrylates have been reported to degrade in aqueous media to produce formaldehyde, which causes inflammation and has got carcinogenicity potential [5]. Other options are now being considered, and among them, photopolymerizable/photocrosslinkable adhesives are the most promising.

The study and development of new biocompatible materials to be applied as UV-curable adhesives is extremely important to grant the preparation of matrices with controlled properties (such as mechanical, biological and thermal) with a fast curing rate when in contact with living tissues. Unsaturated polyesters (UP) present some interesting characteristics to be used in this application due to their inherent biodegradability (ester linkages), potential biocompatibility and to its internal carbon-carbon double bonds that allow them to be photopolymerized forming crosslinked networks [6].

**2. Methods**

Photocrosslinkable biodegradable copolymers were developed based on unsaturated polyesters (prepared from PEG modified with fumaric acid) and lactic acid oligomers (oligoLA) functionalized with 2-isocyanatoethyl methacrylate (IEMA® by BASF).

During this work, three stoichiometric proportions between the UPs and oligoLA were tested, which, after the addition of a biocompatible photoinitiator (Irgacure® 2959 by CIBA), allowed to obtain flexible, resistant and uniform matrices after 2 minutes and 30 seconds of UV irradiation. The prepared materials were then further characterized, by water sorption capacity evaluation, determination of gel content, dynamic contact angles measurements, hydrolytic degradation in vitro, as well as thermal characterization (TGA and DMTA). ATR-FTIR and 1H NMR analyses were performed to allow a follow-up of the synthesis, functionalization and photocrosslinking reactions. Finally, their biocompatibility using human dermal fibroblasts (hFib) and antibacterial activity when incubated with Escherichia Coli and Staphylococcus Aureus were evaluated in vitro.

**3. Results and discussion**

ATR-FTIR and 1H NMR analyses allowed to confirm the reaction between the OH groups of PEG with the COOH of fumaric acid. Also, the bands and peaks correspondent to the C=C bonds were detected in both spectra proving the chemical functionalization of the materials.

Dynamic contact angles determination showed that incorporation of unsaturated polyester leads to more hydrophilic matrices.

It has been found that the rate of degradation of the matrices is closely related to the crosslinking degree and the swelling capacity. In other words, more hydrophilic materials with a lower gel content tended to degrade more rapidly, as did the adhesive composed mainly of UP.

Thermal analysis indicated that the films are stable at physiologic and room temperature. Despite the increase in Tg after curing, this fact does not compromise the film’s flexibility since its value remains lower than physiological and room temperatures.

In cell viability studies, the results obtained were satisfactory for two of the three developed adhesives, with cell viability values of around 100% even after 7 days of incubation. The exception was the adhesive containing the highest amount of the oligomer functionalized, which, in turn, recorded values of 50% at the end of the same incubation period. Also, antibacterial activity in the presence of Escherichia Coli and Staphylococcus Aureus was assessed, and inhibition halos were visualized around the materials, allowing to conclude that they present antibacterial activity.

**4. Conclusions**

The adhesives resulting from the copolymerization of UP and oligoLA functionalized have been shown to be resistant, flexible and with adequate viscosity before a possible application and thermally stable, with very satisfactory crosslinking times.

Considering the obtained results, it is possible to affirm that the UV-curing surgical adhesives developed in this work may come to take a prominent place in the bioadhesive market.

**References**

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