Study of Photostability of Finasteride, Diclofenac and Naproxen Through Exposure of Simulated Sunlight and Evaluation of Packaging Photoprotection of These Drugs

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Abstract

The intrinsic photostability characteristics of pharmaceutical active substances and medicinal products should be evaluated to demonstrate that, as appropriate, light exposure does not result in unacceptable change. The photostability of Finasteride, Diclofenac and Naproxen was studied. The irradiation of the samples was performed according to the conditions suggested by the ICH Guidelines [1] for photostability testing by using a special lamp that reproduces the natural sunlight. The exposition of substances was carried out both as active pharmaceutical ingredients, dissolved in suited solvents, than as solid dosage forms. The concentration of the pharmaceutical active substances was monitored by HPLC. A residual concentration value of 57% of Finasteride, after 90 hours of exposition at 600 W/m^2 of light power, was still present, versus a residual value of just 12% for Diclofenac and 9% for Naproxen measured at the same time.

Introduction

The aim of this study was to investigate if an inappropriate drug package could cause any significant photodegradation of the active ingredient. As indicated in the European Pharmacopoeia [2], a drug should be opportunely protected from light exposure because it can lead to a reduction of concentration of the active ingredient with consequent lost of pharmaceutical efficiency. Furthermore, photodegradation products can be the reason of side effects not only on humans, but also on flora and fauna present in the environment in which drugs are dispersed, either directly or indirectly.

The implementation of ICH guidelines during photostability drug tests could be useful to obtain a scale of stability/recalcitrance of several active ingredients also for solving ecopharmacology problems [3]. So, the study was oriented to the comparison of photostability of three active ingredients among the most consumed in the Italian market during 2005 [4]: Naproxen [5], Diclofenac [6] and Finasteride [7] (two anti-inflammatories and a 5-alpha-reductase respectively).

Materials & Methods

All pure chemicals were purchased from Sigma-Aldrich. Pharmaceutical solid forms of active ingredients were purchased from pharmacies: Prostide containing 5 mg Finasteride, Voltaren 50 containing 50 mg of Diclofenac sodium, Momendol 220 containing 220 mg of Naproxen sodium. All of the marketing packs of three drugs consisted in opaque cardboard boxes.

In order to simulate the natural sunlight, the values of irradiance (W/m^2) and the value of illuminance (lux), of a typical Italian summer day, were studied, using for this aim a radiometer/luxmeter (Gossen, model Mavolux Digital) and a photovoltaic panel, in complying with ICH guidelines. An Osram Ultra-Vitalux Sun Lamp was used as source of electromagnetic radiation, in order to carry out photodegradation tests. The distance of the source from the exposure plane of samples was selected in order to provide a value of 600 W/m^2 and a system of air cooling was used to minimize a possible heat degradation of samples.

Chromatographic analysis was carried out using a HPLC with UV/VIS detector. Chromatographic separation was carried out with an Alltech reversed phase column (Alltima C8 250x4.6 mm I.D., 5μm).

Results & Conclusions

The analysis of samples showed the following experimental results. Naproxen is the pure active ingredient that has the fastest rate of photodegradation in all tested situations and the same order is maintained for active ingredients inside drugs. The tests performed on drugs contained in the marketing pack, lead to a reduction of the active ingredient less than 5%, as required by European Community laws. So the package has performed its function of protection against UV-visible radiations. Little different results has been obtained with active ingredients dissolved in water solution.

Moreover, this work suggests both the use of more efficient methods in wastewater treatment plants, in order to reduce the concentration and the toxicity of active ingredients, especially for molecules that show long environmental persistence like Finasteride, and to equip each plastic blister with UV-blocker filters in order to assure additional protection from radiations. In addition, it could be useful the presence of a "stability indicator" that can show eventual deterioration due to temperature, photolysis, irradiation and recognise counterfeit or expired drugs that are so detrimental to public health and for the image of pharmaceutical companies.

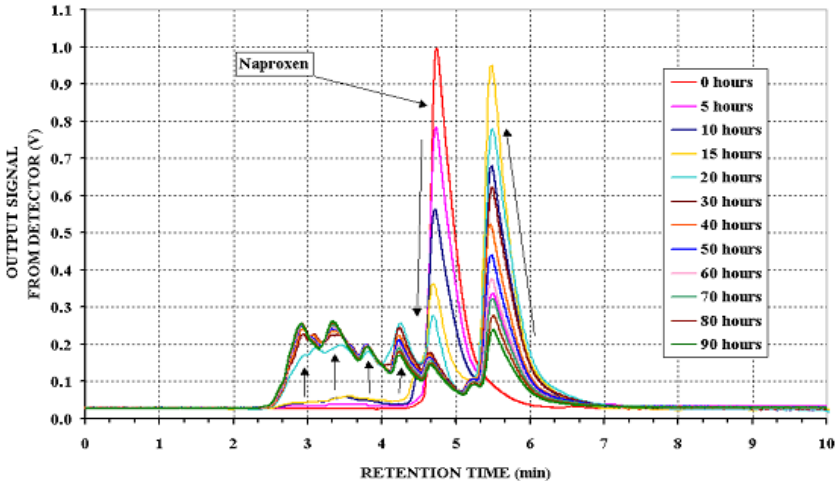

Fig. 1 Chromatograms of Naproxen solution during 90 hours of exposure to simulated sunlight

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