

Characterization of the active pharmaceutical ingredient in film-coated tablets and calculation of the depth of penetration of X-rays

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Purpose. (i) To characterize the drug in intact film-coated tablets by XRD. (ii) Develop a method to estimate the penetration depth of X-rays in film-coated tablets.

Methods. Model bilayer tablets were prepared with a lower layer being a mixture of ceric oxide (10% w/w), blue dye (5% w/w) and microcrystalline cellulose (MCC), while the upper layer consisted only of MCC. Tablets were prepared wherein the thickness of the upper layer ranged from 200 to 700 μm . A microdiffractometer system with a 2-dimensional area detector was used. The incident angle (Ω) ranged 5 to $22.5^\circ 2\theta$, while the detector was fixed at $25^\circ 2\theta$. The penetration depth of X-rays, as a function of the incident angle was calculated. This formed the basis for the determination of the upper layer thickness. It was then compared with the actual thickness of the upper layer, determined by microscopy. After validation of the XRD method, commercial ibuprofen tablets were characterized.

Results. We first developed the method for calculation of the penetration of depth of X-rays and verified it using the model bilayer tablets. Ceric oxide is characterized by an intense peak at $28.6^\circ 2\theta$ ($\text{CuK}\alpha$ radiation). This peak formed the basis for the experimental determination of the depth of penetration of X-rays in the bilayer tablets. The thickness of the upper layer calculated by XRD, was in general, in good agreement with that determined by microscopy. In commercial ibuprofen tablets, the coating material exhibited peaks due to TiO_2 (25.4°) and Fe_2O_3 (33.3°). However, these did not interfere with the characteristic peak of ibuprofen (22.2°).

Conclusion. During pharmaceutical processing (for example, film coating) and storage, the active pharmaceutical ingredient can undergo phase transitions. This is the first reported method for the characterization of the active pharmaceutical ingredient in different regions (at different depths) of the film-coated tablet. Since the technique is nondestructive, the same tablet can be repeatedly analyzed during stability studies.