Can teeth be armed to the teeth? - Time dependence of fluorine uptake by hydroxyapatite

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In terms of caries prophylaxis, fluoridation of enamel aims at the transformation of hydroxyapatite, $Ca_5(PO_4)_3(OH)$ = HAP, as representing the enamel´s main mineral component, into the isostructural fluorapatite, i.e. $Ca_5(PO_4)_3F$ = FAP. The built-up of a FAP layer is expected to provide an effective firewall to resist bacteria mediated acid attacks. In this *in vitro* study, the uptake of fluorine by synthetic HAP samples is investigated in dependence on the application time of the fluoridation agent (here: 500 ppm NaF buffer at pH ~ 5.5 and at 37 °C) via elemental depth profiling using X-ray photoelectron spectroscopy (XPS) combined with Ar ion etching. It is found that with increasing the application time the sub-surface range of the HAP samples saturates at a 41% HAP - 59% FAP mixture which is very close to the 50% : 50% distribution as predicted by molecular dynamic simulations [1]. In addition, the mean thickness of the mixed layer does not exceed the range of 13 nm, which is also close to the value reported in previous experiments [2]. The time constants for obtaining the maximum fluorine content as well as the maximum penetration depth are in the range of approx. 1 min. The present results show that the usual daily practice in dental care is yet close to provide the maximum amount of fluorine possible.

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