



**Development of Resin Composite for Dental Restoration and Recurrent Caries
Prevention Using Fish Scale-Derived Calcium Powder Reinforced with Nanocellulose
Fibers and Fluoride Release as Fluorapatite**

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Abstract

Dental caries is an important public health problem in Thailand across all age groups. To address the limitations of current resin composites regarding durability and secondary caries, this research developed an enhanced resin composite. The team utilized hydroxyapatite powder extracted from Nile tilapia fish scales, a natural material structurally like human teeth and bones, combined with fluoride to form fluorapatite, and reinforced with nanocellulose fibers. X-ray diffraction (XRD) analysis confirmed that both the extracted hydroxyapatite and prepared fluorapatite powders exhibited crystal structures consistent with standard databases. The formulation containing 5 wt% fluorapatite provided the best mechanical properties, yielding a stress of 52 MPa. This achieved the same level as the optimal hydroxyapatite content but required a lower filler amount, thanks to stronger bonding strength and appropriate particle dispersion assisted by ultrasonic sonication. Furthermore, fluorapatite demonstrated the ability to continuously release fluoride during the short-term study period at 0, 6, 12, 24, and 72 hours. When nanocellulose fibers were added at 0.25 wt%, the compressive strength of the resin composite reached its highest level, increasing the yield stress to 61 MPa with relatively uniform filler dispersion. In contrast, adding higher contents of nanocellulose fibers resulted in particle agglomeration and a subsequent reduction in mechanical properties.

Keywords: resin-composite, hydroxyapatite, fluorapatite, fluoride releasing, mechanical properties.