Digital Preservation of West African Cultural Heritage: A Chemical Analysis of Material Degradation in Ethiopian Collections

M, e, k, l, i, t, G, e, b, r, e, m, a, r, i, a, m, ,, T, e, w, o, d, r, o, s, A, s, f, a, w, ,, A, m, i, n, a, M, o, h, a, m, m, e, d, H, a, s, s, a, n

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Abstract

The digital preservation of cultural heritage is a priority in West Africa, but the chemical stability of the physical artefacts being digitised is frequently neglected. This gap is critical for collections in Ethiopia, where environmental conditions threaten material integrity. A chemical understanding of material degradation is necessary to develop informed digital preservation strategies. This study aimed to characterise the chemical degradation processes in selected organic and inorganic artefacts from Ethiopian collections. Its primary objective was to identify key degradation markers and environmental risk factors to prioritise items for digitisation and guide conservation interventions. A multi-analytical approach was employed on samples from parchment, textile, and pigment-based artefacts. Techniques included Fourier-transform infrared spectroscopy (FTIR) for molecular bond identification, X-ray diffraction (XRD) for crystalline structure analysis, and pH testing to assess acidity. Analytical results were correlated with environmental monitoring data for temperature and relative humidity from storage areas. FTIR analysis revealed significant hydrolysis of collagen in parchment, with a mean reduction in characteristic amide band intensity of approximately 40% compared to reference samples. Cellulose-based textiles exhibited advanced oxidative degradation, particularly where relative humidity fluctuated. While pigments such as red ochre were stable, copper-based

greens showed corrosion. Degradation in these collections is active and material-specific. Organic materials are especially vulnerable to hydrolytic and oxidative decay, exacerbated by suboptimal storage conditions. This chemical deterioration directly compromises the fidelity and authenticity of resulting digital surrogates. Immediate environmental stabilisation in storage facilities is essential. Digitisation projects should prioritise artefacts exhibiting early-stage chemical degradation. Routine chemical condition assessments should be integrated into digital preservation workflows to create more resilient and authentic digital heritage records. cultural heritage preservation, digital preservation, material degradation, chemical analysis, Ethiopia, parchment, textiles, pigments This research provides empirical chemical data on artefact degradation specific to an Ethiopian context, offering a scientific basis for prioritising digitisation and enhancing preventive conservation strategies within West African digital preservation programmes.