

Title : Dyeing Pearls with Potassium Permanganate and Aniline

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## ABSTRACT

This study examines the gemological characteristics and dyeing methods of 15 samples of pinkish-purple freshwater pearls to achieve the Chocolate Pearls desired by the gemstone market. The samples were opaque, weighing between 2.73 and 3.60 grams, with specific gravity values ranging from 2.63 to 2.70. Fluorescence testing under long- and short-wave ultraviolet radiation revealed blue fluorescence in two undyed samples (Sample 1 and Sample 12), while all dyed samples exhibited no fluorescence under either wavelength. Advanced instrumental analysis using Fourier-transform infrared (FTIR) spectroscopy identified carbonate ( $\text{CO}_3^{2-}$ ) peaks at 1485, 1082, and 712  $\text{cm}^{-1}$ . Scanning electron microscopy with energy-dispersive spectroscopy (SEM-EDS) analysis showed elemental composition consisting of 18.79% carbon, 27.82%

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oxygen, and 53.38% calcium. The dyeing process was categorized into three groups: potassium permanganate ( $\text{KMnO}_4$ ), aniline ( $\text{C}_6\text{H}_5\text{NH}_2$ ), and a combination of potassium permanganate and aniline, with dye concentrations of 0.2 M  $\text{KMnO}_4$  and 5.49 M aniline to achieve market-preferred pearl colors. It was found that dyeing with potassium permanganate for five days altered the pinkish-purple pearls to a golden-yellow color, known in the gemstone market as South Sea pearls. FTIR analysis of the dyed samples revealed only minor peak variations at the same positions, while SEM-EDS analysis showed no significant surface changes. The elemental composition of the dyed pearls was 20.69% carbon, 30.16% oxygen, and 49.14% calcium. Dyeing with aniline alone or in combination with potassium permanganate for one day did not result in noticeable color changes, though it slightly reduced pearl luster. To further study color transformation and dye durability, pearls previously dyed with aniline or a combination of aniline and potassium permanganate were subjected to an additional five days of potassium permanganate dyeing. The aniline-pretreated pearls turned golden-yellow but exhibited uneven coloration. SEM-EDS analysis revealed increased surface roughness, with elemental composition of 21.37% carbon, 21.19% oxygen, and 57.44% calcium. Pearls dyed with the combination of potassium permanganate and aniline turned brown, referred to in the gemstone market as Chocolate Pearls. SEM-EDS analysis showed increased surface roughness and an elemental composition of 23% carbon, 26.77% oxygen, 21.51% calcium, 1.99% potassium, and 26.74% manganese. Chemical durability testing indicated that the dyed pearls were resistant to acetone and detergent but showed slight fading when exposed to dishwashing liquid.