Mechanism of Laccase-assisted Tyrosine Grafting on Keratin using BSA as a Model Protein

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Abstract

Commercial hair perming uses strong reducing agents and is harmful to hair fiber's quality even human health. In this study, tyrosine is adopted as a cross-linking agent between thiols as the shape-changing of hair involves breakage of disulfide bonds and the rearrangement of new bonds between keratin molecules. To investigate the mechanism of the cross-linking, bovine serum albumin (BSA) is used as a model protein. Molecular dynamics simulations give an insight on Cys solvent accessibility and protein stability for the wild type BSA and a designed BSA presenting the three broken disulfide bonds. A new cross-linked peptide, NECFLSHK-Tyrosine-Tyrosine-GACLLPK, inter- or intra- BSA monomers is formed, whose reactive cysteine residues are Cys-101 and Cys-176. Moreover, curling of Asian hair is conducted using tyrosine as a perming agent by laccase-assisted reaction. The optimized operational conditions are hair with cysteine pre-treatment (50.0 mM) followed by grafting with 3.0 mM tyrosine. The reshaped hair performed a better perming performance than commercial perming product before washing, although a lower perming efficiency after washing, however without strength loss and could be easily accomplished with a blow-drier. Hence, this new methodology may lead to the development of a gentle and user-friendly approach in the hair care industry.

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