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The Attachment of Dyes To Amino Acids

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Doctor of Philosophy

by

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Abstract

Reactive dyes are a class of dyes where the dye is attached to the fibre (eg. wool) through a covalent bond. To form such a bond they require an active group capable of undergoing reaction with the nucleophilic sites in the fibre. The active group is normally either a carbon with a leaving group which can undergo nucleophilic substitution reactions or an alkene activated by either a carbonyl or a sulfonyl group, which can undergo Michael addition reactions. The search for new types of reactive dyes with better properties, such as increased wet and light fastness, higher fixation, and greater stability to dye bath conditions, continues. Accordingly the Michael addition of the side chain functional groups of cysteine, lysine and serine with a series of alkynes, both terminal and non-terminal, attached to carbonyl groups, from a representative sample of functional group types was examined. The relative reactivities of both the alkynes and the amino acid side chains were determined. The most reactive alkynes were found to be those conjugated to ketones and esters. Mild reaction conditions were found under which the Michael addition reactions occur efficiently and in good yield.

Linker arms terminating in conjugated alkynes were attached to four dyes, fluorescein; Sudan 1; 7-hydroxy coumarin; and a dansyl sulfonamide adduct. The types of conjugated alkynes represented by these compounds were terminal alkynyl esters and alkynyl amides, and non-terminal alkynyl ketones. The reactions of these derivatised dyes with the amino acid side chains were studied. These additions were found to occur easily and in reasonable yield.

The applicability of a conjugated alkyne reactive group for the attachment of dyes to proteins was examined. Sudan 1 functionalised by the addition of a linker arm ending in a terminal alkynyl ester was found to react readily with the nucleophilic moieties present in keratin to yield orange dyed wool. The colour was found to have a better than expected fastness to treatment with washing powders.