



Structure and mechanism of formation of human lens fluorophore LM-1. Relationship to vesperlysine A and the advanced Maillard reaction in aging, diabetes, and cataractogenesis.

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Human lens crystallins become progressively yellow-brown pigmented with age. Both fluorescent and non-fluorescent protein adducts and cross-links are formed, many of which result from the advanced Maillard reaction. One of them, LM-1, is a blue fluorophore that was earlier tentatively identified as a cross-link involving lysine residues (1). A two-step chromatographic system was used to unequivocally identify and quantitatively prepare a synthetic fluorescent cross-link with lysine residues that had identical UV, fluorescent, and chromatographic properties with both acetylated and non-acetylated LM-1. Proton, (13)C NMR, and molecular mass of the synthetic compound were identical with vesperlysine A, a fluorescent cross-link discovered by Nakamura et al. (2). The fragmentation patterns of vesperlysine A and LM-1 were identical as determined by NMR/mass spectrometry. Lenticular levels of vesperlysine A increase curvilinearly with age and reach 20 pmol/mg at 90 years. Levels correlate with degree of lens crystallin pigmentation and fluorescence and are increased in diabetes, in contrast to N(epsilon)-(carboxymethyl)lysine and pentosidine. Ascorbate, D-pentoses, and D-threose, but neither D-glucose under oxidative conditions, DL-glyceraldehyde, methylglyoxal, glyoxal, nor glycolaldehyde, are precursors. However, addition of C-2 compounds greatly catalyzes vesperlysine A formation from ribose. Thus, vesperlysine A/LM-1 is a novel product of the advanced Maillard reaction in vivo and a specific marker of a diabetic process in the lens that is different from glyco- and lipoxidation.

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