

*Yuan-Fong Lin*<sup>b</sup>  
*Ing-Kai Wang*<sup>a</sup>  
*Hsueh-Hsia Wu*<sup>a</sup>  
*Chin-Ta Chen*<sup>a</sup>  
*Hornng-Mo Lee*<sup>\*a</sup>

<sup>a</sup> School of Medical Technology,

<sup>b</sup> Graduate Institute of Pharmaceutical  
Sciences,

Taipei Medical College

Taipei 110-31, Taiwan, R.O.C.

## Elevation of Serum Advanced Glycosylation End Products in Diabetic Patients

### Key Words

Advanced glycosylation end products

ELISA

Diabetic complications

HbA<sub>1c</sub>

### ABSTRACT

Reducing sugars react with amino groups of proteins to form a variety of fluorescence-producing advanced glycosylation end products (AGEs). Serum low-molecular-weight AGEs (LMW-AGEs) have been linked with the development of diabetic-associated cardiac vascular complications. In this report, we raised antibodies specifically against AGEs and developed a competitive enzyme-linked immunosorbent assay (ELISA) to determine the serum LMW-AGEs in 2 age groups of non-diabetics and 1 group of diabetics. By defining 1 AGEs unit (AU) as the inhibition that results from 1:5 diluted pooled serum in competitive ELISA, we found that the circulatory AGEs levels in the young group as well as those in the elderly group of non-diabetics fit normal distributions ( $p < 0.05$ ) and their reference ranges were  $3.12 \pm 0.52$  ( $n = 30$ ) and  $4.41 \pm 1.1$  AU ( $n = 36$ ), respectively. The circulation AGEs levels in diabetic patients were  $8.96 \pm 2.13$  AU ( $n = 32$ ) which is significantly higher than in both age groups of non-diabetics. The circulation AGEs data correlated well with the HbA<sub>1c</sub> values obtained from patients with diabetes ( $r = 0.86$ ). In conclusion, these data reveal that circulation AGEs are higher in the elderly as compared to those of the young group and may serve as a circulation marker reflecting the severity of the diabetic sequel.

### INTRODUCTION

Aging or prolonged elevation of glucose levels in diabetes patients results in a number of complications including nephropathy, atherosclerosis, retinopathy, neuropathy, and cataracts. These complications have

been related to the non-enzymatic glycosylation reaction, also termed the "Maillard reaction".<sup>1</sup> The process is a non-enzymatic reaction of free amino groups of proteins and reducing sugars. This reaction proceeds from reversible Schiff bases to stable covalently bounded Amadori rearrangement products. With time,