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Stabilization of the collagen structure by hydroxyproline residues*

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ABSTRACT

The molecular structure of collagen is now accepted to be based on a triple-stranded coiled-coil, in which the three strands are held together predominantly by hydrogen bonds. Recent experimental evidence has shown that the presence of hydroxyproline residues in the third position of the repeating tripeptide unit lends additional stability to the collagen structure. In this paper, we report a model structure, which is supported by these observations. In a model structure proposed earlier, there are two hydrogen bonds per tripeptide unit, one of which is a direct interchain hydrogen bond, while the second hydrogen bond can be formed *via* a water molecule. It has now been shown that the same water molecule can also form a hydrogen bond with the oxygen of the γ-hydroxyl group of hydroxyproline in the third position in the sequence (Gly-R_2-R_3).

This hydroxyl group can also take part in an inter-triple-helix hydrogen bond. Our studies thus show the role played by hydroxyproline residues in the structure and stability of collagen.

INTRODUCTION

THE molecular structure of the fibrous protein collagen is now generally accepted as corresponding closely to the 'one-bonded' triple helical model[1, 2]. In this model a second set of interchain hydrogen bonds is also possible, with a water molecule acting as an intermediary, so that two of the amino groups per tripeptide are involved in hydrogen bond formation[3]. Various types of hydrogen exchange studies[4] and also the more recent hydrogen-tritium exchange studies[5] support a 'two-bonded' model.

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