Pressure dependency of the collagen-type triple helix analyzed by High pressure macromolecular crystallography (HPMX) up to 1GPa

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Abstract

Helicoidal molecular structures are a very common feature in biology, whether in the case of the DNA/RNA world or in the field of enzymes/proteins.There is a wide variety of helical arrangements, from single strand (n=1) to tetraplex (n=4). Thus, DNAs/RNAs (n=2) involve the formation of a complementary double stranded scaffold, or even a quadruplex (n=4) in the case of guanine-rich oligomers. In the case of proteins and depending on the composition of their sequence, they most commonly fold into a single helix (n=1) whose pitch angle may adopt different values (alpha-helix, Helix 3/10, pi-helix…). However, in the case of sequences rich in glycine and proline, they can adopt an unusual triple helix combination (n=3). This is the case of sequences found in collagen fibrils where the motif (G-X-X)- becomes dominant (with X = mostly a proline). Under high hydrostatic pressure, DNA structures (n=2) are known to exhibit extreme resistance [1], which reinforces the hypothesis of their primary role in difficult prebiotic times when the conditions for building "replicable" blocks emerged and living organisms appeared.

We report in this presentation the pressure behaviour of the helicoidal structure of collagen (n=3), using the synthetic fragment formed by the repeating triplet proline-proline-glycine, which triple helical scaffold is illustrated by a number of relevant structures in the PDB. The sequence we use here is the standard 30-mer $(PPG)_{10}$.

Just like the helical structure of the DNA (n=2), the triple helix of $(PPG)_{10}$ has an extraordinary resistance to the pressure that we analysed by X-ray diffraction..

1. Prangé T. *et al*. Behavior of B- and Z-DNA Crystals under High Hydrostatic Pressure. *Crystals* (2022) **12**, 871. doi: 10.3390/cryst12060871.