Solving the riddle of nature's perfect spring

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(PhysOrg.com) -- Scientists have unravelled the shape of the protein that gives human tissues their elastic properties in what could lead to the development of new synthetic elastic polymers.

University of Manchester researchers, working with colleagues in Australia and the United States, used state-of-the-art techniques to reveal the structure of tropoelastin, the main component of elastin.

Elastin allows tissues in humans and other mammals to stretch, for example when the lungs expand and contract for respiration or when arteries widen and narrow over the course of a billion heart beats.

The study, published in the science journal *PNAS* (March issue), revealed how evolution has triumphed where engineering has so far failed by generating a molecule with near-perfect elasticity that will last a lifetime.

"All mammals rely on elastin to provide their tissues with the ability to stretch and then return to their original shape," said researcher Dr Clair Baldock, from the University of Manchester's Wellcome Trust Centre for Cell Matrix Research. "This high level of physical performance demanded of elastin vastly exceeds and indeed outlasts all human-made elastics.

"It is the co-ordinated assembly of many tropoelastins into elastin that gives tissues their stretchy properties and this exquisite assembly helps to generate elastic tissues as diverse as artery, lung and skin.

"We discovered that tropoelastin is a curved, spring-like molecule with a 'foot' region to facilitate attachment to cells. Stretching and relaxing experiments showed that the molecule had the extraordinary capacity to extend to eight-times its initial length and can then return to its original shape with no loss of energy, making it a near-perfect spring."

She added: "Elastics are used in applications as diverse as clothing, vehicles, tissue engineering and even space travel, so understanding how the structure of tropoelastin creates its exceptional elastic properties will hopefully enable the development of synthetic 'elastin-like' polymers with potentially wide-ranging applications and benefits."

Initiator and research project leader Tony Weiss, Professor in the School of Molecular Bioscience, The University of Sydney, added: "Tropoelastin is a tiny protein 'nanospring' in the human body. Our bodies assemble these nanosprings to put elasticity into tissues like skin, blood vessels and lung.

"Our finding is the result of more than a decade of international collaboration. Our scientific teamwork spans Australia, the UK, USA and Europe. Tropoelastin's extraordinary capacity to extend to eight-times its initial length and then return to its original shape, with no loss of energy, is nature showing us how to make an ideal nanospring."

More information: 'Shape of tropoelastin, the highly-extensible protein that controls human tissue elasticity,' *PNAS*. dx.doi.org/10.1073/pnas.1014280108

Provided by University of Manchester