



International Journal of Proteomics & Bioinformatics

Short Communication

Revised Estimate of Total Collagen in the Human Body -

Gary B. Smejkal^{1*} and Cody Fitzgerald²

¹*Focus Proteomics, Hudson, New Hampshire, USA*

²*Department of Mathematics and Statistics, University of New Hampshire, Durham, NH, USA*

***Address for Correspondence:** Gary B. Smejkal, Focus Proteomics, Hudson, New Hampshire, USA,
E-mail: info@focusproteomics.com

Submitted: 05 August 2017; **Approved:** 18 August 2017; **Published:** 18 August 2017

Cite this article: Smejkal GB, Fitzgerald C. Revised Estimate of Total Collagen in the Human Body. *Int J Proteom Bioinform.* 2017;2(1): 002-003.

Copyright: © 2017 Smejkal GB. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.



ABSTRACT

Based on global mean adult body mass, it was calculated that the human body, on average, contains 3.6×10^{21} molecules of collagen type 1. This revised estimate is nearly four times higher than previously published estimates.

Keywords: Collagen; Collagen type 1; Proteins; Proteomics; Neptune; Tropocollagen

Collagen is the most abundant protein in the animal kingdom. In vertebrates, 28 different types of collagen composed of 46 distinct polypeptide chains have been identified [1] and collagen fibrils are reportedly five to ten times stronger than steel [2]. The collagen type 1 monomer is a triple helix 300 nm in length assembled from three protein subunits. It is synthesized in the rough endoplasmic reticulum as a 407,000 Da precursor. Later, specific peptidases cleave terminal propeptides to yield the mature tropocollagen monomer of approximately 300,000 Daltons.

Based on global averages, mean adult human body mass is 62.0 kg. This ranges from 80.7 kg in North America, which comprises only 6% of the world population, to 57.7 kg in Asia, which holds 61% of the world population [3]. On average, total protein mass is 15.1% of total body mass [4] and over 25% of the body's total protein mass is collagen. At least 80% of the body's total collagen is collagen type 1.

Based on the global mean adult body mass, we have calculated there are approximately six millimoles of collagen type 1 in the human body which, when multiplied by Avogadro's number, equals 3.6×10^{21} molecules. This is nearly four times higher than previously published estimates of 1×10^{21} molecules calculated for a 70 kg body mass [5].

Even by the most conservative estimate, if all of the collagen type 1 monomers in the human body were outstretched and lined

end to end, the resulting filament would span approximately 3×10^{14} m. Remarkably, this length would trace the orbit of the planet Neptune over ten times. To put this distance into better perspective, travelling at an average speed of 5.4 km per second, Neptune has completed only one orbit since its discovery in 1846.

ACKNOWLEDGEMENTS

The authors thank Professor Marianna Shubov, University of New Hampshire, Department of Mathematics and Statistics and Patricia DiBello, Cleveland State University, Department of Chemistry for their review of this work.

REFERENCES

1. Shoulders MD and Raines RT. Collagen structure and stability. *Annu Rev Biochem.* 2009; 78: 929-58. <https://goo.gl/SFg4Dn>
2. Buehler MJ. Nature designs tough collagen: Explaining the nanostructure of collagen fibrils. *Proc Natl Acad Sci U S A.* 2006; 103: 12285-90. <https://goo.gl/Peoh3N>
3. Walpole SC, Prieto Merino D, Edwards P, Cleland J, Stevens G, Roberts I. The weight of nations: An estimation of adult human biomass. *BMC Public Health.* 2012; 12: 439. <https://goo.gl/hcm2GC>
4. Wang Z, Shen W, Kotler DP, Heshka S, Wielopolski L, Aloia JF, et al. Total body protein: A new cellular level mass and distribution prediction model. *Am J Clin Nutr.* 2003; 78: 979-84. <https://goo.gl/NX84ox>
5. Di Lullo GA, Sweeney SM, Korkko J, Ala-Kokko L, San Antonio JD. Mapping the ligand-binding sites and disease-associated mutations on the most abundant protein in the human, type I collagen. *J Biol Chem.* 2002; 277: 4223-31. <https://goo.gl/ysX1Lg>