Path integral for helical protein chains

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It is shown that proceeding from the spiral stationary form of the protein chains one can deduce, in a unique way, the explicit expression for the relevant free energy. Namely, the free energy density should be a linear function of the curvature k of the curve which describes the shape of the central line of the protein molecule. Minimization of this energy gives for the pitch-to-radius ratio of the helices the value 2π. The model also enables one to estimate qualitatively the release of the free energy under the transition of the protein chain from the straight line form to the spiral form. The free energy proposed by us implies, in particular, that the effective bending energy of the protein chain is not proportional to $k2$, as it is usually adopted in the physics of semi-flexible polymers, but this energy is linear in the curvature k. The relation of this model to the rigid relativistic particles and strings is briefly discussed. The consideration relies on proving the complete integrability of the variational equations for the functionals defined on smooth curves and dependent on the curvature of these curves. The construction of the relevant functional integral is discussed briefly.