1.2.2 Translation

When a protein is translated from mRNA, it is created from N-terminus to C-terminus. The amino end of an amino acid (on a charged transfer RNA [tRNA]), during the elongation stage of translation, attaches to the carboxyl end of the growing chain. Since the start codon of the genetic code codes for the amino acid methionine, most protein sequences start with a methionine (or in bacteria, mitochondria, and chloroplasts, the modified version *N*-formylmethionine, fMet). However, some proteins are modified posttranslationally, for example, by cleavage from a protein precursor, and, therefore, may have different amino acids at their N-terminus.

1.2.3 Peptide bond

The chemical link between amino acids is called a *peptide bond*. It is formed between the carbonyl oxygen and carbon, with α-carbons on each side of the peptide bond, and the amide nitrogen and hydrogen, and is due to the partial double bond character that exists between the carbonyl carbon and the amide nitrogen atoms (Figure 1.4). The peptide bond has a planar structure that produces restrictions in the angular range of bond rotation around the Cα–N, expressed by ϕ (phi), and C–Cα, expressed as ψ (psi) bonds. These restrictions are summarized in a two-dimensional graphical plot called a Ramachandran plot; the plot graphically shows how certain structural features of proteins can only exist within limited ranges of angles, e.g., α-helix.

The ω angle at the peptide bond is normally 180° since the partial double bond character keeps the peptide planar. Because the dihedral angle values are circular, and 0° is the same as 360°, the edges of the Ramachandran plot "wrap" right to left and bottom to top (Figure 1.5).

The higher-order structure (HOS) of proteins includes secondary, tertiary, and quaternary structures as shown in Figure 1.6.

Figure 1.7 shows the three-dimensional (3D) structure of a filgrastim, a recombinant protein widely used for the treatment of neutropenia.

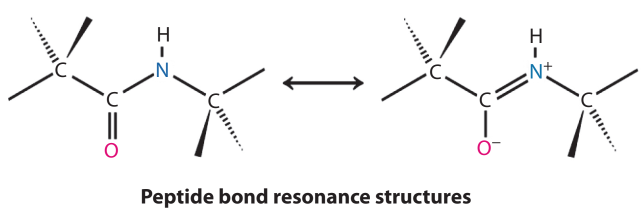

Figure 1.4 Peptide bond; the double bond character is about 40% due to resonance. (From Berg, J. M., J. L. Tymoczko, and L. Strye, *Biochemistry*, Seventh edition, W. H. Freeman and Co., New York, 2010.)