# Holistic view of proteins: amino acids and post-translational modifications

Proteins are essential in every part of life. They are a source of essential amino acids, which are the essential building blocks for *in vivo* protein synthesis. However, considering proteins only as a source of essential amino acids is reductionistic and applies only to storage proteins. Most proteins, as well as peptides derived therefrom, also have many other biologically important functions, *e.g.*, as antibodies, enzymes, carrier of nutrients or as hormonal proteins. These biological functions of proteins are the result of the specific folding of the polypeptide chain, as well as post-translational modifications of protein, which occur during protein synthesis. Hence, a holistic view of proteins considers them on the basis of tertiary and quaternary structure, including post-translational modifications, rather than a reductionistic approach of only considering basic amino acid composition.

For milk proteins, two main types of post-translational modifications are present, *i.e.*, phosphorylation and glycosylation. The former, phosphorylation, is present primarily on the caseins, and is crucial for the key biological function of caseins, in all mammalian milks, including human milk, as a carrier of calcium, magnesium and phosphate. Due to this mineral binding capacity of caseins sufficiently high levels of these minerals can be transported in bioavailable form from the mother to the neonate to sustain growth of the latter. Likewise, glycosylation, which is present on both the caseins and the whey proteins, also in human milk, has several important biological functions. First of all, protein glycosylation affects protein folding and thereby biological function. Furthermore, glycosylation is important for specific recognition of proteins by other molecules or mimicking host glycans, thereby playing important roles for e.g., antibodies and modulating adhesion.

The role of proteins in human milk, thus, goes far beyond that of (simple) storage proteins which only provide essential amino acids. This also holds for proteins in products used as alternatives in cases where human milk cannot be provided to the neonate, *i.e.*, infant formula and follow-on-formula. Therefore, the significance of these proteins can only be considered based on the whole protein, *i.e.*, including post-translational modification. Based hereon, for milk proteins, 6.38 is the appropriate nitrogen conversion factor.

More information:
IDF Bulletin n°482/2016: Evaluation of the Nitrogen conversion factors for dairy and soy
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