Protective milk proteins – new insights and prospects for health promotion

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Our knowledge about the biological role of bovine colostrum and milk has expanded significantly over the last three decades. We know now that the mammary secretions do not only contain nutrients, but like other exocrine secretions- saliva, tears, bronchial and nasal secretions etc.- present many natural protective systems which are multifunctional, e.g. provide protection against microbial infections, activate the host's immune system, modulate metabolic processes and interfere in gene expression. These protective systems are based primarily on proteins (including enzymes), the best characterized ones posing the lactoperoxidase-hydrogen peroxide-thiocyanate system (LPS), lysozyme (LZM), lactoferrin (LF), and specific antibodies represented by immunoglobulins (Igs). The non-antibody protective systems are derived from ancient proteins, predating the evolution of humoral and cellular immunity: LP- the biological reduction of oxygen producing free radicals is scavenged by superoxide dismutase, catalase and peroxidase –all defences against toxicity of O_2. The precursor of tissue LZM is bacteriophage lysin, detected in cyanobacteria. LF occurs in spider, crabs etc. before vertebrates. The recently discovered dual oxidases, generating H_2O_2 in the epithelial cells of the salivary gland ducts and along mucosal surfaces of colon, rectum and major airways play a crucial role in activation of the LPS. Thus, dual oxidases represent the "missing link" that completes the oxidant dependant antimicrobial system-LPS- another component of MALT (Mucosal Associated Lymphoid Tissue).

The profile of protective systems in bovine and human milk, and leucocytes is remarkably similar, suggesting that the bovine-derived components may act, upon oral ingestion, in humans in the same way as those in human milk. This has led to the exploration of the role of digested bovine milk proteins. Both caseins and whey proteins, including LF, have proven a rich source of peptide sequences with multifunctional bioactivities, e.g. antimicrobial, anti-hypertensive, anti-oxidative and immunomodulatory. These peptides can be released from native proteins in hydrolysis with digestive or microbial enzymes offering interesting prospects for commercial applications. Future research is needed on the interactions between peptides and protective proteins and probiotic bacteria, respectively, and interaction of peptides with gut mucosa and commensal microbiota. Also, the use of modern tools of proteomics and metabolomics will reveal genomic aspects of the milk –derived protective systems.

The progress in commercial exploitation of the bioactive systems available in bovine colostrum and milk has been surprisingly slow. The current global interest in developing heath-promoting functional foods provides a timely opportunity to tap the myriad of innate bioactive milk components for inclusion in such formulations. They could be targeted to infants, elderly and immune-compromised people as well as to improve performance and prevent diet-related chronic diseases.