Milk protein: new insights into functions and quality

Milk protein has more functions than previously known. The quality of milk protein is higher than previously estimated.

The traditional anabolic functions of protein remain important, yet recent research has identified protein also to have additional metabolic and neutraceutical roles, many of which are specific to milk protein. Common protein quality assessment methods underestimate the quality of milk protein. Protein intake recommendations for optimal health should therefore be reassessed.[1]

FUNCTIONS OF MILK PROTEIN

The biologically active components of dairy have been labelled as 'neutraceuticals',[4] resulting in milk and dairy being classified as functional foods.[9]

Milk protein consists of a soluble whey fraction and a less soluble casein fraction, each containing a unique mix of essential amino acids and bioactive compounds. The classical functions of proteins – anabolism, biological catalysis, plasma and membrane transport, movement, structure, protein folding, immunity, growth and differentiation – also apply to milk protein.[2] In addition, the bioactive peptides of dairy has distinctive functions, including involvement in nutrient transport, immunomodulation, gastrointestinal function and flora maintenance, cell signalling and antimicrobial and antiviral activity.[3,4,5] Milk protein also has beneficial effects on metabolic conditions such as hypertension, dyslipidaemia and mild hyperglycaemia. Dairy protein may indirectly aid weight management through its effect on satiety and body composition.[1,6,7] Osteoporosis and bone health are also related to dairy protein intakes, and in the elderly milk proteins appear to prevent age-related loss of muscle mass.

MILK PROTEIN QUALITY

Protein quality refers to the ability of a food-derived protein to meet the metabolic demand of the (human) body for amino acids and nitrogen.[1] Various criteria and markers are used to define dietary protein requirements. In addition to the composition of a food protein, physiological criteria such as digestibility and bioavailability are key in describing protein quality.[5] The available methods range from nitrogen balance, biological value profile, protein efficiency ratio, net protein utilisation and amino acid scores. The latter includes the protein digestibility-corrected amino acid score (PDCAAS) and the digestible indispensable amino acid score (DIAAS).[1,10,12,14,15,16]

The PDCAAS is widely used for protein quality description in spite of some limitations. These include a so-called truncation rule, according to which the biological value of a protein may not exceed 100%.[12,17] This means that proteins with essential amino acids beyond those in the reference protein, as is the case for milk protein, do not get due credit. The supplementation power value of milk protein is considerable, particularly with regard to supplementing the limiting amino acids from plant proteins. A second limitation is that the current methods do not take into account amino acid availability, anti-nutritional factors of plant protein and gastrointestinal factors. Thus, proteins of high biological value, such as milk protein, are of better quality than the PDCAAS method suggests.

It has been proposed that when determining protein quality, proteins' the unique functions should be considered beyond providing amino acid building blocks. Researchers and health practitioners need to integrate the newfound functions of milk protein, peptides and amino acids in their interpretation and planning of diets. It follows that protein function and quality have become interlinked.[5,10]

IMPLICATIONS FOR PROTEIN REQUIREMENTS

Protein requirement is defined as being 'the lowest level of dietary protein intake that will balance the losses of nitrogen from the body'. New evidence challenges scientists to rethink this definition for the following reasons:

- As protein quality decreases, the percentage of energy in the diet provided by protein must increase to meet protein requirements. Consequently more protein must be consumed to meet amino acid and nitrogen requirements.[18,19,20]
- The required amount of essential amino acids per gram of protein for children is now considered to be higher than the currently used international recommendations. Children in developing countries are subject to repeated infections, chronic energy deficiency and poor sanitation. Such conditions are very different from the ideal situation for which the requirements have been defined.[18,21]
- Cows' milk protein is key to the treatment of severe acute malnutrition (SAM). Adding dairy protein to the diet improves protein quality, which allows the required total protein content of a product or diet to be reduced. By including milk protein in the treatment of SAM linear growth may improve without excess body fat gain; it is associated with increased muscle mass or higher functional test scores. By using less soy and cereal in the treatment of SAM, potential anti-nutritional effects of plant proteins are reduced.[23,24,26,27]
- Current recommendations do not yet consider the recently established 'new' metabolic and neutraceutical functions of protein.[6,25]

CONCLUSIONS

The importance of the protein in milk is now appreciated more than ever before. The quality of milk protein has been found to be higher than previously acknowledged and the functions of dairy protein involve more than only providing amino acids and nitrogen. Recommending daily intake of dairy products as part of the new South African food-based dietary guidelines affirms the nutritional value of milk protein. "Have milk, maas or yoghurt every day"[28] is a step in this direction.

A more comprehensive referenced review is available on www.rediscoverdairy.co.za under Dairy-based nutrition.

REFERENCES

1. Boye J. *et al. Br J Nutr* 2012; 108:S183-S211.
2. Brosnan JT & Young VR. *Nutr Metab. Blackwell Publishing.* 2003. Chapter 4 (pp43-73).
3. Perreira PC. *Nutr 2013.* doi: 10.1016/j.nutr.2013.10.011.
4. Severin S & Wenshiu X. *Crit Rev Food Sci Nutr* 2005;45:645-656.
5. Millward DJ. *et al. Am J Clin Nutr* 2008;879(suppl):1576S-1581S.
6. Mc Gregor RA & Poppitt SD. *Nutr Metab* 2013;10:46 (http://www.nutritionandmetabolism.com/content/10/1/46).
7. Pal S & Radavelli-Bagatini S. *Obesity Reviews* 2013;14:324-343.
8. Heaney RP & Layman DK. *Am J Clin Nutr* 2008; 87(suppl):1567S-1570S.
9. Bhat ZF & Bhat H. *Int J Dairy Sci* 2011;6(1):1-12.
10. Tome D. *Br J Nutr* 2012; 108: S222-S229.
11. Gilani GS *et al. Br J Nutr* 2012a;108:S315-S332.
12. Schaafsma G. *Br J Nutr* 2012;108:S333-S336.
13. Barbe F *et al. Food Chem* 2014;143;1-8.
14. Bos C *et al. J Am Coll Nutr* 2000;19(2):191S-205S.
15. Millward DJ. *Br J Nutr 2012*; 108:S31-S43.
16. WHO/FAO/UNU. *WHO Technical Report Series 935*. Geneva. FAO/WHO/UNU, 276. 2007.
17. Gilani SG. *Br J Nutr* 2012b;108:S168-S182.
18. Uauy R. *Food Nutr Bull* 2013a;34(2):228-231.
19. Pencharz P. *Food Nutr Bull* 2013;34(2):237-239.
20. Millward JD & Jackson AA. *Publ Health Nutr* 2003;7(3):387-405.
21. Kurpad A. *Food Nutr Bull* 2013;34(2):234-236.
22. Michaelsen KF. *Food Nutr Bull* 2013a;34(2):249-251.
23. Hoppe C. *et al. J Nutr* 2008;138:145S-161S.
24. Uauy R. *Food Nutr Bull* 2013b;34(2):259-262.
25. Tome D. *Food Nutr Bull* 2013;34(2):272-274.
26. Michaelsen. *KF. Food Nutr Bull* 2013b;34(2):268-271.
27. Allen L. *Food Nutr Bull* 2013;34(2):263-266.
28. Vorster HH *et al. S Afr J Clin Nutr* 2013;26(3)Suppl:S57-S65.

AN INITIATIVE BY THE CONSUMER EDUCATION PROJECT OF MILK SA
For further information contact:

Tel: 012 991 4164 • Fax: 012 991 0878

www.rediscoverdairy.co.za
info@dairy.co.za