

This Week's Citation Classic

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McKenzie H A. Milk proteins. *Advan. Prot. Chem.* **22**:55-234, 1967.
[Dept. Physical Biochemistry, Institute of Advanced Studies, Australian National Univ., Canberra, ACT, Australia]

The occurrence, isolation, and properties of milk proteins are reviewed. The individual proteins exhibit an array of interactions. The problems that these pose in the study of the proteins are discussed. Attention is given to milk proteins in allergenicity. Present knowledge is critically assessed and predictions are made concerning future research. [The SC[®] indicates that this paper has been cited over 140 times since 1967.]

Hugh A McKenzie
Department of Physical Biochemistry
John Curtin School of Medical Research
Institute of Advanced Studies
Australian National University
Canberra City. ACT 2601
Australia

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"No major review of the chemistry of milk proteins had appeared since that of McMeekin in 1954,¹ just prior to the commencement of a new era in the methods of protein chemistry. Soon after his review, two major discoveries did much to stimulate new work: that by von Hippel and Waugh² of a new casein component, κ -casein, considered responsible for the stabilization of milk micelles and that by Aschaffenburg and Drewry³ of genetic variants. Thus the field was ripe for review.

"I believed that the unique significance of milk proteins in nutrition and protection of the newborn alone justified their study. However, they possess physico-chemical properties that make them of great importance in protein chemistry. Their interactions pose particular problems in their study Hence special attention was given in the review to the pitfalls involved, and the precautions necessary for proper study.

"While I endeavoured to give a clear overall picture. I made no apology for emphasising certain aspects, and giving examples from my own work.

This policy brought criticism from two readers, but the majority of the opinions received in the past 14 years have been laudatory. Thus, I believe, the approach has proved valuable, and it is this which accounts for the article's frequent citation. Another feature was that predictions were made concerning future discoveries as well as suggestions for future research. A particularly pleasing aspect has been that a number of these have proved to be valid, e.g., that the 'proteose peptones' are essentially caseins⁴ and that variants without charge differences would be found.⁵

"Since 1967 there have been some remarkable advances in our knowledge of proteins, and of milk proteins in particular. The amino acid sequences of the major bovine milk proteins are now known. There is considerable knowledge of the proteins of other species. Nevertheless, we still do not know the detailed conformation of any of these proteins⁶ (with the possible exception of α -lactalbumin). Also in 1967 it was stated in the last sentence of the review. 'Only when we can understand the many reactions of whole milk will we be able to say that we understand the proteins.' This has still not been attained in 1981.

"The article is probably unique among *Citation Classics* in that the idea of it was conceived in a prison. During the early 1960s Kevin Bell of the University of Queensland and I were studying the new lactoglobulin variant, β -lactoglobulin C. At that time the only homozygous animal located conveniently close to the university was at the Wacol prison. I often had to wait for considerable periods before the formalities of movement were completed and had time to contemplate: thus the idea was born (another example of Alyea's relevance of irrelevance). The real impetus to writing the article was provided by sabbatical leave spent during 1965 at the Frick Laboratory of Princeton University in the stimulating environment of a longtime friend. Walter Kauzmann. It provides an example of how important such sabbaticals are to those of us who are located in the antipodes."

1. McMeekin T L. Milk proteins. (Neurath H & Bailey K. eds.) *The proteins: chemistry, biological activity, and methods* New York: Academic Press, 1954. Vol. 2A. p. 389-434.
2. Waugh D F & von Hippel P H. κ -casein and the stabilization of casein micelles. *J. Amer. Chem. Soc.* **78**:4576-82, 1956.
3. Aschaffenburg R. Genetic variants of milk protein: their breed distribution. *J. Dairy Res.* **35**:447-60, 1968.
4. Andrews A T. The composition, structure and origin of proteose-peptone component 5 of bovine milk. *Eur. J. Biochem* **90**:59-65, 1978.
5. Bell K, McKenzie H A & Shaw D C. Bovine β -lactoglobulins E, F and G of Bali (banteng) cattle. *Bos (Bibos) javanicus. Aust. J Biol Sci.* **34**:133-47, 1981.
6. Green D W, Aschaffenburg R, Camennan A, Coppola J C, Dunnill P, Simmons R M, Komorowski E S, Sawyer L, Turner E M C & Woods K F. Structure of bovine β -lactoglobulin at 6 Å resolution. *J. Mol. Biol.* **131**:375-97, 1979.