INTRODUCTION

α-lactalbumin, a major whey protein (123 amino acids, 14KDa) present in the milk of most mammals and accounts for 28% of the total protein in human milk. α-lactalbumin has been described to have several important physiological functions. The aim of this paper is to summarize the current knowledge of α-lactalbumin and important biological functions.

FUNCTIONS OF ALPHA-LACTALBUMIN

- Role in lactose synthesis
- Source of amino acids and growth stimulating peptides
- Antimicrobial and anti-inflammatory properties
- Role in mood and cognition
- Role in apoptosis in form of MAL & HAMLET
- Possible role in mammary gland development

MULTIMERIC ALPHA-LACTALBUMIN AND HAMLET

- The multimeric α-lactalbumin (MAL) form isolated from the casein fraction of milk can induce apoptosis in tumor cells, but not in healthy cells.
- In order for MAL to induce apoptosis, Ca²⁺ must be present or protein synthesis must proceed.
- Both α-lactalbumin and MAL bind to the cell membrane, with no difference in cell binding between variants. However, only MAL enters the cytoplasm, accumulating in the nucleus.
- Caspases are shown to be activated (cysteine-containing aspartate-specific proteases) by MAL and are involved in its induction of apoptosis.
- The direct interaction of MAL with mitochondria leads to the release of cytochrome c, a step which may be crucial in the activation or amplification of the caspase cascade in some cells.
- HAMLET (human α-lactalbumin made lethal to tumour cells) is a complex of apo α-lactalbumin and oleic acid, converted to an active form in vitro, which like MAL, has shown to selectively kill tumour cells while sparing normal healthy cells.
- This contrasts with 28kD LALBA which is active as a natural fraction and shows indiscriminate killing and also and contrasts with 14 kD LALBA.
- Studies have also shown that complexes of human Ca²⁺-free α-lactalbumin with oleic acid formed at 17 and 45°C at pH 8.3 and aggregates of apo bovine α-lactalbumin induced by oleic acid and linoleic acid at pH about 4 are HAMLET like complexes that show cytotoxic activity against cancer cells.

CONCLUSION

α-lactalbumin is a multi-facetted protein, which not only plays a role in lactose synthesis within the cell as a monomer, but acquires a completely different function as a dimer once it is secreted into milk. In the form of HAMLET, α-lactalbumin presents an appealing alternative in cancer treatments. Future directions for the apoptotic 28kDa α-lactalbumin may also include a use to irradiate breast tumor cells by loading 28kDa α-lactalbumin onto silicon nanoparticles allowing specific targeting to tumor cells. α-lactalbumin may also be a target of interest to the dairy industry for improved milk production as the blocking of α-lactalbumin dimer formation may act to prolong lactation in dairy cows.

BENEFIT TO DAIRY INDUSTRY

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