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Biophysical characteristics of human milk proteins for enhancing tear stability in dry eye

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Footnotes

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Abstract

Purpose : Dry eye disease affects millions of people worldwide and is prevalent in older people, females, contact lens wearers, and increasingly in the general population due to excessive use of visual display devices. Tear instability is the characteristic pathophysiology of the disease due to the inability of tears to form a stable film on the ocular surface, which leads to drying of the ocular surface. Enhancing tear stability is known to relieve symptoms of dry eye. Human breast milk (HBM) has been shown to contain proteins that enhance ocular surface healing following injury. In healthy tears, tear proteins increase tear stability by showing surface-active properties. The aim of

this project was to study the biophysical characteristics of HBM proteins and compare them with the proteins found in tears as a first step to explore the use of HBM constituents for treatment of dry eye.

Methods : HBM samples were fresh frozen, then thawed, centrifuged, and aqueous recovered for lyophilisation. The aqueous containing proteins was used in the experiments. Pressure-area profiles and rheology of surface films of HBM proteins and tear proteins, namely, lysozyme and lactoferrin were studied using Langmuir trough technology on an artificial tear solution at the physiological pH and temperature of tears.

Results : Pressure-area profiles indicated that HBM proteins formed a highly compressible, non-collapsible surface film with a maximum surface pressure of 32mN/m. The surface films of lysozyme and lactoferrin were also compressible with the maximum surface pressures of 23mN/m and 17mN/m, respectively. Hysteresis was observed in all proteins with smallest in lactoferrin and highest in lysozyme.

Conclusions : HBM proteins are surface active and capable of reducing surface tension to increase the film stability. They are effective in smaller amounts, show higher surface pressure, and wider surface coverage than tear proteins lysozyme and lactoferrin. Overall, the biophysical experiments indicate that HBM proteins in smaller amounts would provide better protection to the tear film than the natural proteins of the tear film and can be effective in enhancing tear stability in dry eye.

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