# Lactoferrin Uptake Kinetics on Silicone Hydrogel and Conventional Hydrogel Contact Lens Materials

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## Introduction

- Previous studies have proposed that lactoferrin sorbed on to contact lens materials can promote bacterial adhesion, since their carbohydrate moieties may act as receptors for bacterial lectins. [1,2] In a more recent study, it was shown that lactoferrin deposited on the lens surface promotes the adhesion of *Pseudomonas aeruginosa* strain *Paer 1*; nevertheless, once adherent, this protein reduces the proportion of viable bacteria on the lens surface. [3]
- Recent data suggest that silicone hydrogel (SH) lens materials deposit extremely low levels of protein compared to conventional FDA group IV lens materials. [4-7] Few studies have determined the kinetics of protein and lipid deposition on conventional hydrogel (CH) and SH lens materials, [7-9] with lysozyme being the only protein examined.
- Very few studies have investigated the deposition of lactoferrin on CH [3,10-13] and SH contact lens materials, [14] and these studies have examined the lactoferrin deposition only after a specified period of time. To date, no study has determined the kinetics of lactoferrin deposition on contact lens materials.

## Purpose

The purpose of this study was to compare the lactoferrin uptake kinetics on FDA group II, FDA group IV CH lens materials and the first & second generation SH lenses, using an *in vitro* radiolabelling method.

## Materials & Methods

**Table 1:** Characteristics of CH lens materials evaluated in this study.

| Proprietary name | Proclear | Acuvue 2 |
|---|---|---|
| USAN | omafilcon A | etafilcon A |
| Manufacturer | Cooper Vision | Johnson & Johnson |
| Water content | 62% | 58% |
| FDA group | II | IV |
| Surface Treatment | None | None |
| Principal monomers | polyHEMA+PC | polyHEMA+MA |

polyHEMA, poly(2-hydroxyethyl methacrylate); PC, phosphorylcholine; MA, methacrylic acid.

**Table 2:** Characteristics of SH lens materials evaluated in this study.

| Proprietary name | Night & Day | $O_2$Optix | PureVision | Acuvue Advance | Acuvue OASYS |
|---|---|---|---|---|---|
| USAN | Lotrafilcon A | Lotrafilcon B | Balafilcon A | Galyfilcon A | Senofilcon A |
| Manufacturer | CIBA Vision | CIBA Vision | B&L | J&J | J&J |
| Water content | 24% | 33% | 36% | 47% | 38% |
| Dk | 140 | 110 | 91 | 60 | 103 |
| CT -3.00D | 0.08 | 0.08 | 0.09 | 0.07 | 0.07 |
| Dk/t | 175 | 138 | 101 | 86 | 147 |
| FDA group | I | I | III | I | I |
| Surface Treatment | 25 nm plasma coating | 25 nm plasma coating | Plasma oxidation | None | None |

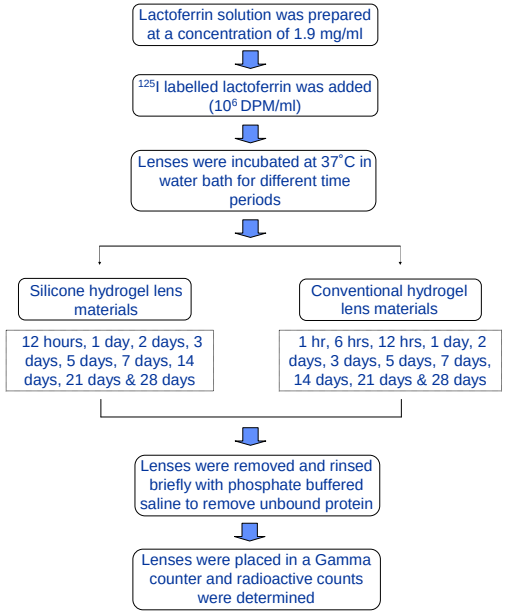


**Figure 1:** Schematic of protocol adopted to determine the kinetics of lactoferrin deposition on different contact lens materials.

## Results

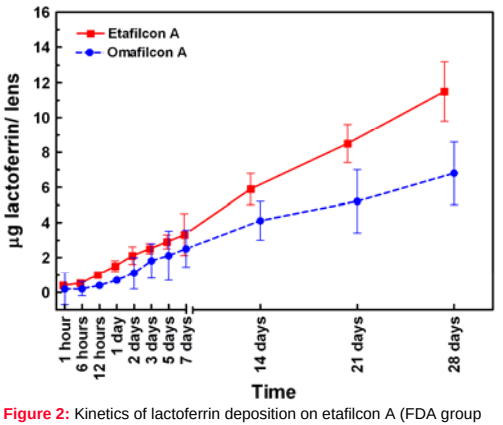


**Figure 2:** Kinetics of lactoferrin deposition on etafilcon A (FDA group IV) and omafilcon A (FDA group II) lens materials. (Mean ± SD, n=3).

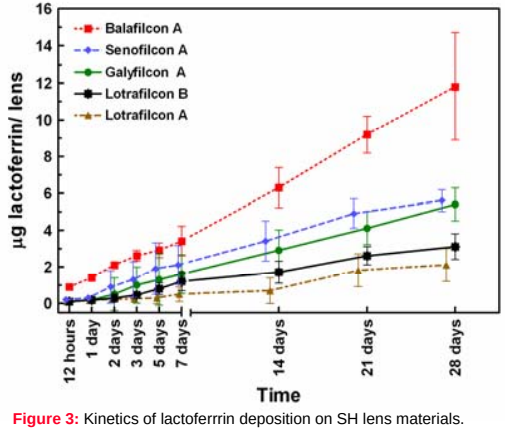


**Figure 3:** Kinetics of lactoferrrin deposition on SH lens materials. (Mean ± SD, n=3).

- Figure 2 compares the lactoferrin deposition on two CH lens materials. Etafilcon A deposited the greatest amount of lactoferrin compared to omafilcon A and the amount of lactoferrin deposition increased significantly after day 7 ($p<0.05$). At the end of 28 days, etafilcon A deposited 11.3±1.9 µg lactoferrin/lens and omafilcon A deposited 6.8±2.0 µg lactoferrin/lens, which was significantly different ($p=0.03$).
- Figure 3 shows that balafilcon A deposited significantly more lactoferrin than all the other SH lens materials ($p<0.05$) and that the degree of deposition increased significantly after day 7 ($p<0.05$), with each time-point thereafter monotonously increasing ($p<0.05$). Galyfilcon A and senofilcon A demonstrated a moderate amount of deposition, while lotrafilcon A and lotrafilcon B deposited the least amount of lactoferrin. There were no statistical differences between the five SH lens materials until day 7 (all $p>0.05$).
- At day 28, there was a statistical difference between lotrafilcon A and lotrafilcon B versus all other SH lenses ($p<0.05$), and a statistical difference between galyfilcon A and senofilcon A versus all other SH lenses ($p<0.05$). At the end of 28 days the amount of lactoferrin/lens in µg was 11.8±2.9 for balafilcon A, 2.1±0.9 for lotrafilcon A, 3.1±1.0 for lotrafilcon B, 5.4±1.1 for galyfilcon A and 5.6±0.6 for senofilcon A.

## Conclusions

- Radiolabelling is a sensitive and reproducible technique to determine small quantities of protein deposited on contact lenses.
- Lactoferrin deposition onto hydrogel lens materials is time dependent, with longer sorption times resulting in higher degrees of deposition.
- Currently available SH lens materials broadly fall into one of three categories, based upon their surface treatment. Interestingly, these three 'families' of SH lenses show significant differences from each other in terms of their lactoferrin deposition. Thus, the degree of lactoferrin deposition is dependent on the ionicity and also the surface treatment of the material under test.

## References

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