The uptake and release of Myristamidopropyl Dimethylamine (MAP-D) from Soft Reusable Contact lenses

A. Yee, C.M Phan, V.W. Chan, M. Heynen, L.W. Jones
Contact e-mail: a3yee@uwaterloo.ca

Centre for Ocular Research & Education (CORE), School of Optometry & Vision Science, University of Waterloo,

Introduction

- The uptake and release of biocides from contact lens (CL) materials has been linked to microbial keratitis and potential cytotoxic responses.[1,2]
- Myristamidopropyl dimethylamine (MAP-D) is used as an antifungal and antiprotozoal agent in Alcon's Opti-Free products (Aldox®).[3]
- Several studies have assessed the uptake and release of MAP-D and other biocide components from CL materials using HPLC techniques.[4,5,6]
- However, HPLC is time consuming and can have relatively low sensitivity.

Purpose

- The purpose of this study was to assess the uptake and release of radiolabeled MAP-D on soft reusable CL materials over 7 days.

Methods

- Three silicone hydrogel (SH) materials (lotrafilcon A, balafilcon A, senofilcon A) and two conventional hydrogel (CH) materials (omafilcon A, etafilcon A) were tested.
- PBS (ISO 18369-3); radioactive 14C (Moravek Inc., California, USA); MAP-D (5µg/mL).
- Experiment 1 (N = 4 per material) assessed the 24-hr uptake and release kinetics of MAP-D from CLs.
  - incubation period of 8 hours followed by a release period of 24 hours in 2 mL PBS.
  - Aliquots at t = 0.25, 0.5, 1, 2, 4, 8, 24 hours.
- Experiment 2 (N = 3 per material) assessed the uptake and release of MAP-D from CLs over a 7-day period.
  - CLs incubated in fresh 2 mL MAP-D solution for 8 hours followed by a 16-hour release in PBS.
- An extraction of MAP-D from the lenses used hexane:isopropanol and chloroform:methanol.
- Added the samples to scintillation fluor (PerkinElmer, USA) and counted the radioactive signal (Beckman Coulter, CA).
- Radioactive counts per minute (CPM) was converted to µg based on a standard curve.

Results

Table 1. Summary of results for experiment 1

Lens type	Total uptake (mean±SD)	Total release (mean±SD)	Extraction amount	Percent release
Lotrafilcon B	6.32±0.14 µg	0.67±0.04 µg	5.80 µg	11%
Balafilcon A	6.13±0.38 µg	0.55±0.03 µg	5.73 µg	9%
Senofilcon A	6.45±0.21 µg	0.57±0.02 µg	6.05 µg	9%
Etafilcon A	4.00±0.35 µg	1.66±0.11 µg	2.49 µg	42%
Omafilcon A	2.45±0.04 µg	1.78±0.03 µg	0.82 µg	73%

Figure 1. Release kinetics of MAP-D over a 24-hour period (mean±S.D). The release kinetics were significantly different between the materials (p<0.01)

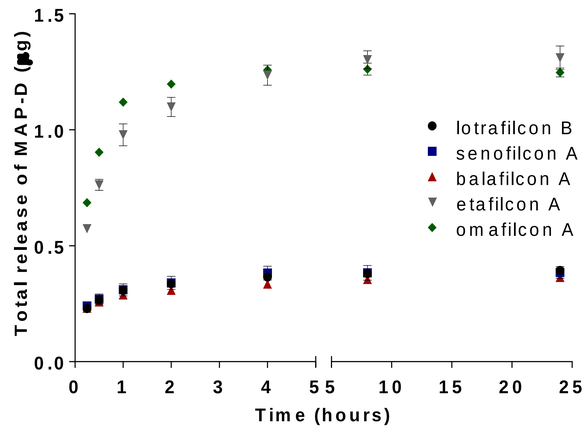
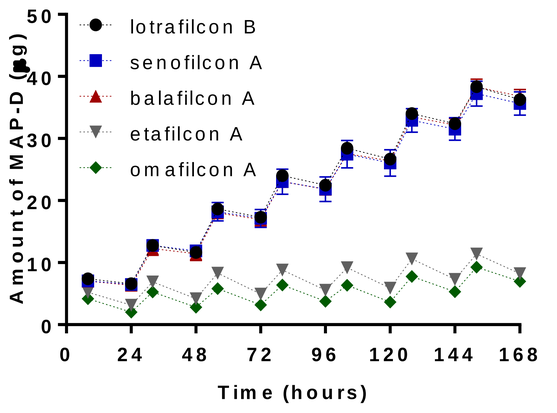


Table 2. Summary of results for experiment 2

Lens type	Total uptake (mean±SD)	Total release (mean±SD)	Extraction amount	Percent release
Lotrafilcon B	44.05±10.63 µg	10.15±0.49 µg	33.90 µg	25%
Balafilcon A	43.55±1.08 µg	8.11±0.53 µg	35.44 µg	19%
Senofilcon A	42.57±1.20 µg	8.00±0.43 µg	34.57 µg	19%
Etafilcon A	26.88±0.57 µg	21.44±0.71 µg	5.44 µg	80%
Omafilcon A	18.85±0.42 µg	17.60±0.36 µg	1.25 µg	93%

Figure 2. Release kinetics of MAP-D over a 24-hour period (mean±S.D). The release kinetics were significantly different between the materials (p<0.01)



Results continued

- **Experiment 1**
- The total uptake of MAP-D for SH materials was significantly greater than the CH materials (Table 1, p<0.01).
- CH materials (etafilcon A and omafilcon A) released more MAP-D than the SH materials (Figure 1, *p*<0.001).
- The percent release was significantly different between the lens materials after 1-day and 7-days (*p*<0.01).
- **Experiment 2**
- SH materials continued to sorb more MAP-D over 7-days (p<0.01) with no signs of saturation (Figure 2, p<0.01).
- No significant differences in the amount of MAP-D sorbed between the SH materials (p=0.99), however, etafilcon A sorbed more MAP-D than omafilcon A (Table 2, p<0.01).
- There was a significant difference in the percent of MAP-D released between the SH and CH materials (p<0.01).

Conclusions

- Radioactive labelling offers a highly sensitive and accurate technique to measure uptake and release of biocides from CL materials.
- Etafilcon A sorbed less MAP-D than the SH materials, but released a greater amount and percentage of MAP-D that was sorbed.
- The surface chemistry of the SH materials may not have a major impact on the sorption of MAP-D.
- The uptake and release kinetics of MAP-D may be driven by the siloxane content within the CL materials.

References

1. Specht CS, Laver NV. (2016) Epidemiology and Clinical Significance of Ocular Infection. In: Laver NV and Specht CS. The Infected Eye: Clinical Practice and Pathological Principles; 1-11.
2. Chang *et al.* (2006) Multistate outbreak of Fusarium keratitis associated with use of a contact lens solution. JAMA; 296: 953-963.
3. Jones L, Christie C. Soft Contact Lens Solutions Review Part 2:Modern-Generation Care System. *Optometry in Practice* 2008; 9: 43-62.
4. Powell *et al.* (2010) Lipophilic versus hydrodynamic modes of uptake and release by contact lenses of active entities used in multipurpose solutions. CLAE; 33: 9-18.
5. Green *et al.* (2012) Material properties that predict preservative uptake for silicone hydrogel contact lenses. Eye Contact Lens; 38: 350-357.
6. Morris *et al.* (2018). Consequences of preservative uptake and release by contact lenses. Eye Contact Lens; 44 Suppl 2 S247-S255.

Disclosures

A.Y (none), V.W.C (none), M.H (none), L.W.J (Code F (Alcon, Allergan, CooperVision, J&J Vision, GL Chemtech, Menicon, Nature's Way, Novartis, Shire); Code S (Alcon, CooperVision, J&J Vision, Santen, Shire); Code C (Alcon, CooperVision, J&J Vision, Novartis, Ophtecs)