Degradability Enhancers Based on Photopolymerizable Acetal Building Blocks for Artificial Bone Grafts

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INTRODUCTION

Tissue Engineering:

- Biomaterials as alternative to autotransplants
- Requirements: **biocompatibility** and **biodegradability**

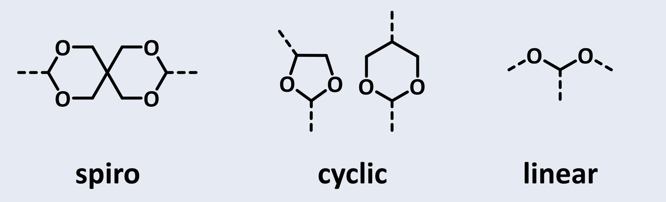
Up to now used materials based on **polyesters**, but:

- **Slow degradation** under acidic conditions (pH ≤ 3 during bone regeneration)
- **Acidic degradation products** lead to inflammation and necrosis

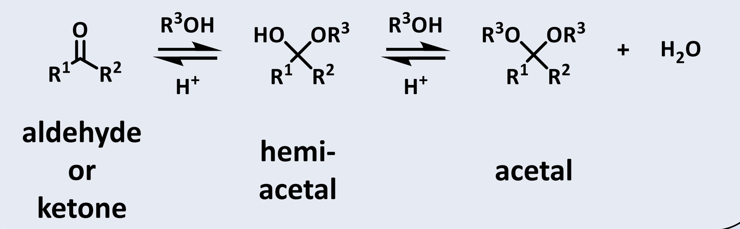
Acetals:

- Alternative to polyesters
- Stable under neutral and basic conditions
- **Degradation speed tunable** with structure variation

Structures:



Synthesis:



MOLECULAR DEGRADATION STUDY

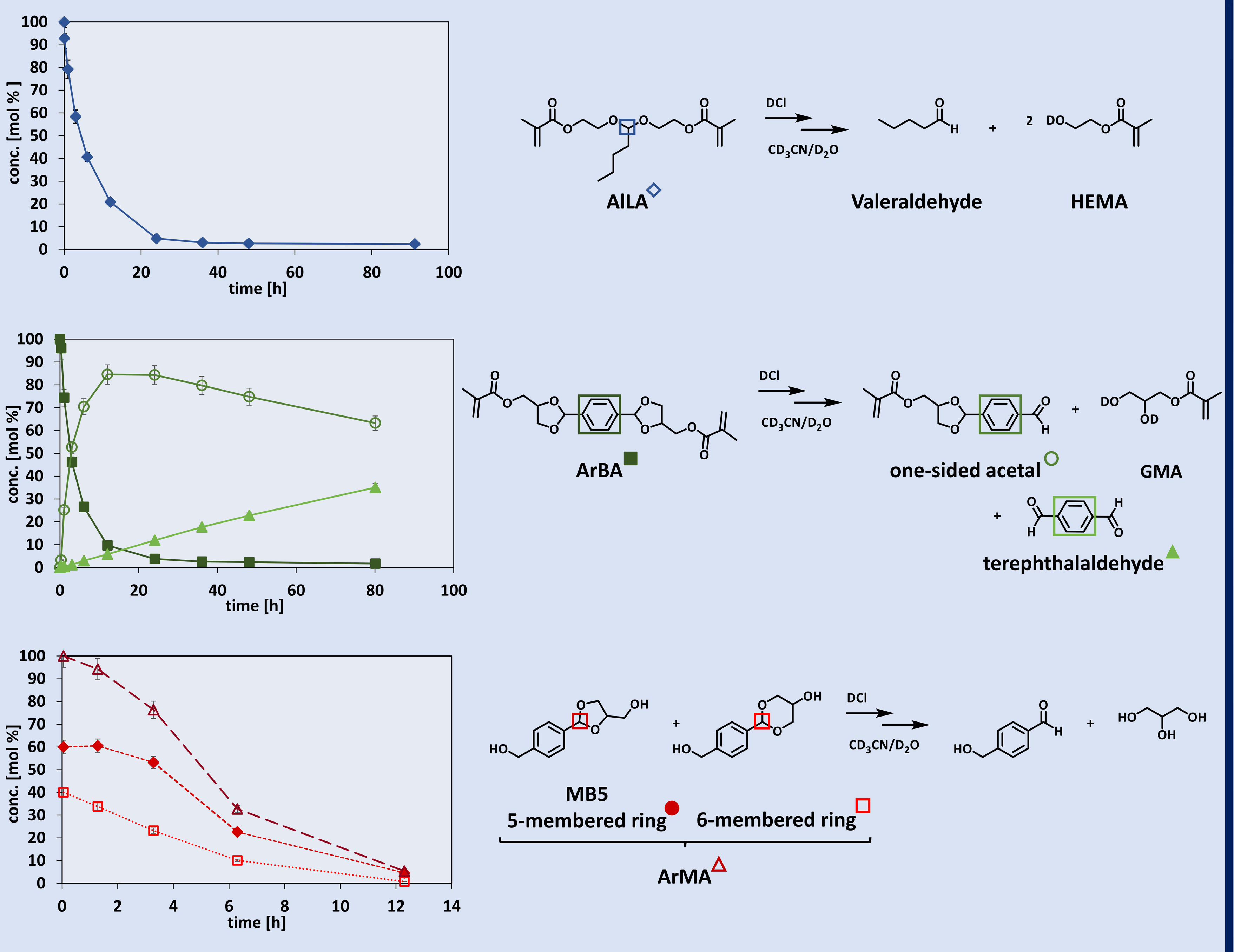


Fig. 1:
Concentration of acetal moiety of **AlLA**, **ArBA** and **ArMA** over time in $CD_3CN:D_2O$ (1:1) + 0.5 µl DCl (38 wt% DCl in D_2O), pH-equivalent of 2.1 determined by ^{1}H-NMR spectroscopy.

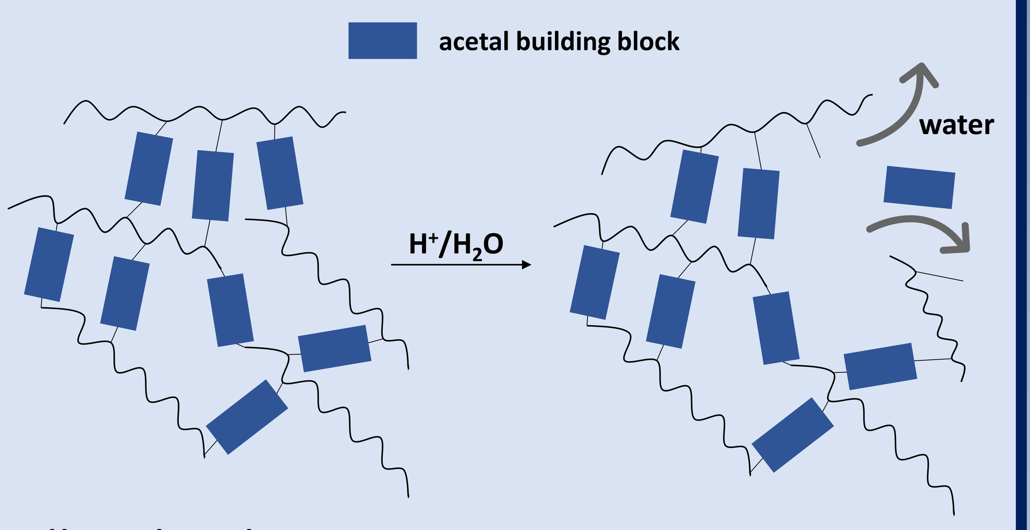
NETWORK DEGRADATION STUDY

Increase of mass:

- Due to spontaneous swelling
- Further swelling due to network degradation

Mass-erosion:

- Due to wash-out/elution of small molecules



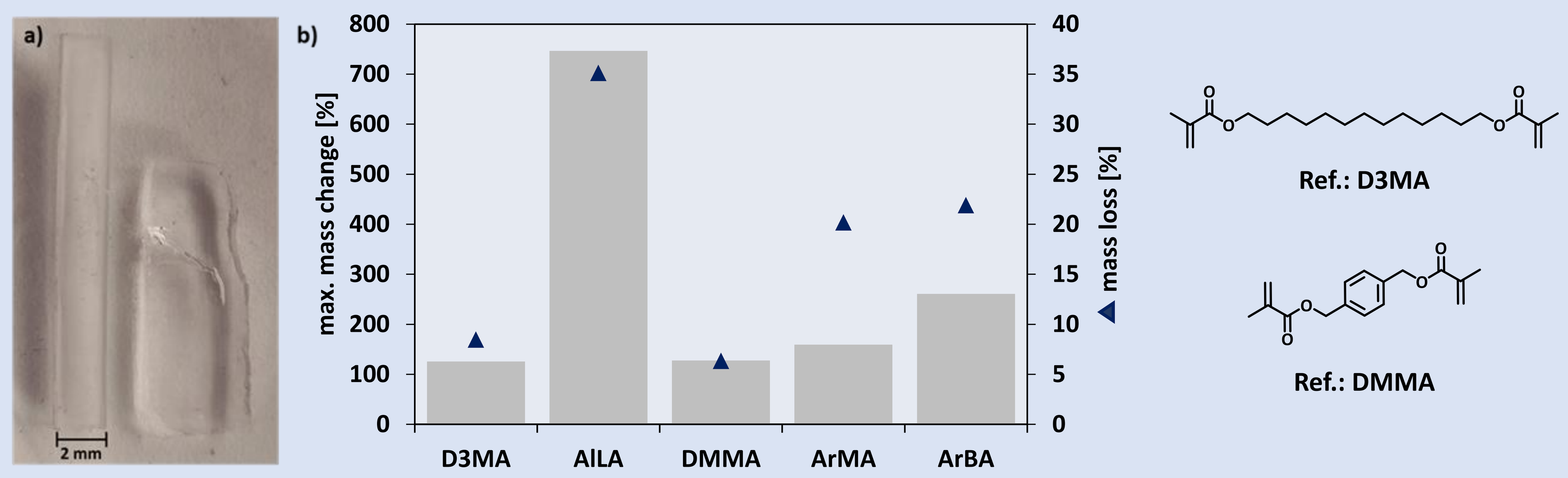
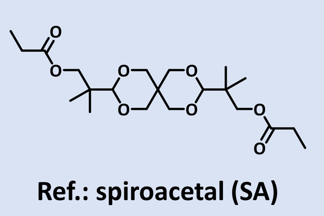


Fig. 2:
a) Photopolymerized polymer network of **AlLA** before and after 5d of immersing in a HCl/KCl solution (pH = 2.2 at 37 °C).
b) Max. mass change [%] and mass loss [%] after const. drying compared to their init. mass for aliph. Ref. **D3MA** (within 246d), **AlLA** (within 5d), the arom. Ref. **DMMA**, **ArMA** (both within 246d) and **ArBA** (within 233d).

CONCLUSION & OUTLOOK

- Successful synthesis of acetal containing degradability enhancers
- Spiroacetal also stable under acidic conditions
- Acetals degrade **faster by a factor of 80-200** compared to ester moiety
- Network degradation confirmed molecular degradation mechanism



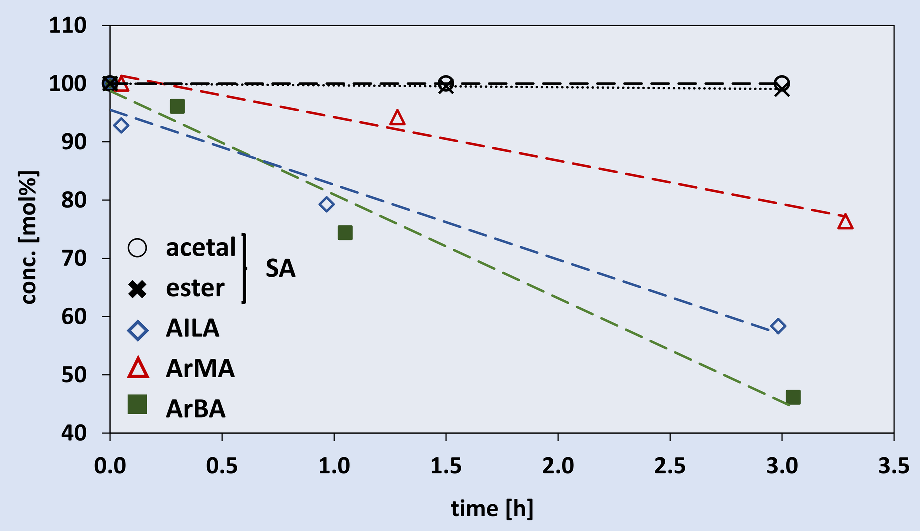
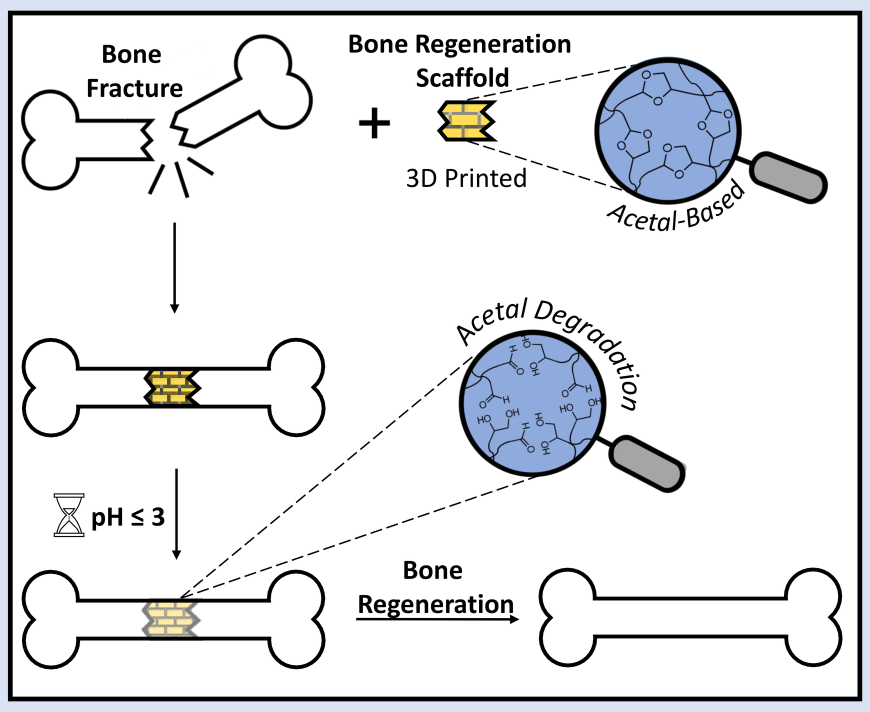


Fig. 3:
Degradation velocity within the first 3h.

- **Further degradability studies:** Separation of swellability and mass erosion effects
- **New acetal-based monomers:** Variation of photopolymerizable functionalities



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The financial support by the Austrian Federal Ministry for Digital and Economic Affairs and the National Foundation for Research, Technology and Development is gratefully acknowledged.