Synthesis of Pendant Aldehyde Polymers for Biological Applications

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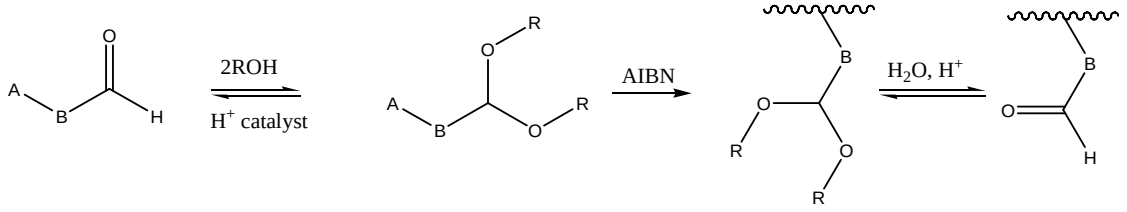
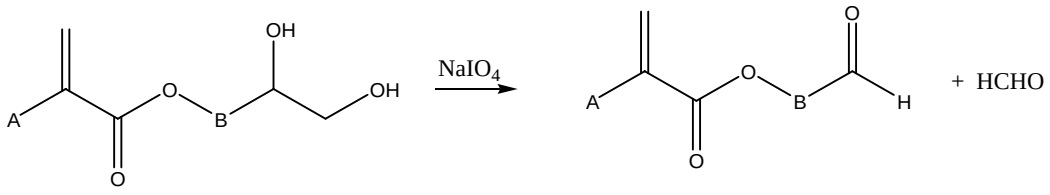
The use of polymers for biological purposes, particularly as drugs or drug carriers, attracts a great deal of interest, as polymers offer a number of advantages over traditional candidates. The focus of this research is the synthesis of polymers that contain pendant aldehyde groups. The principal application of these polymers is anticipated to be as antimicrobial agents, as aldehydes have well-established antimicrobial properties, arising from their high reactivity towards the amino groups of proteins on the surface of microorganisms.[1]

The polymerization of monomers that contain aldehyde moieties using radical or ionic techniques is difficult to control, due to interference of the carbonyl group.[2] This results in structures that are poorly defined and difficult to characterize. To circumvent this problem, aldehyde moieties can be protected as acetals, polymerized and then deprotected (Scheme 1).



Scheme 1: Synthesis of pendant aldehyde polymers via acetal protection

Aldehyde monomers were synthesized via oxidative cleavage of 1,2-diol monomers using sodium periodate supported on silica (Scheme 2). The 1,2-diol monomers used were 2,3-dihydroxypropyl methacrylate (1), 2,3-dihydroxypropyl acrylate (2) and 5,6-dihyoxyhexyl acrylate (3).



(1) A = CH_3, B = CH_2
(2) A = H, B = CH_2
(3) A = H, B = $(CH_2)_4$

Scheme 2: Oxidative cleavage of 1,2-diols

The aldehyde monomers were then reacted with methanol to yield dimethoxy acetals, which were polymerized using free radical techniques. Acid catalyzed hydrolysis of the resulting acetal polymers gave pendant aldehyde polymers (Figure 1).

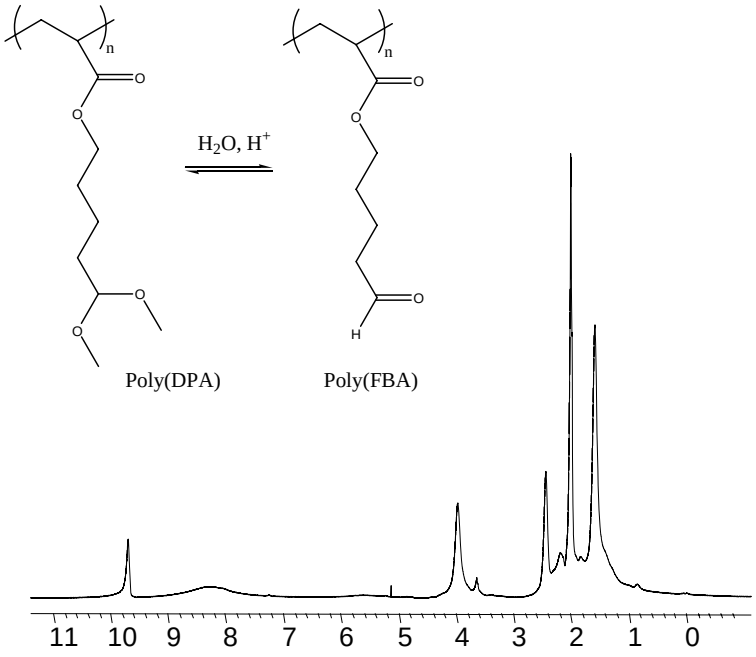


Figure 1: ^{1}H NMR spectrum of poly(4-formylbutyl acrylate) (poly(FBA))

In summary, we have demonstrated the synthesis of aldehyde monomers via the oxidative cleavage of the 1,2-diol compounds 2,3-dihydroxypropyl methacrylate, 2,3-dihydroxypropyl acrylate and 5,6-dihyoxyhexyl acrylate. These aldehydes were treated with methanol to give dimethoxy acetal monomers, which were polymerized using free radical techniques. Acid catalyzed hydrolysis of the acetal groups produced pendant aldehyde polymers. Biological testing of these polymers as antimicrobial agents is currently in progress in the Department of Microbiology at the University of Melbourne.

References;

(1) Hampson, D. J.; Murdoch, A. I. *Avian pathology* **2003**, *32*, 605-611.
(2) Guiver, M. D.; Zhang, H.; Robertson, G. P.; Dai, Y. *Journal of Polymer Science, Part A: Polymer Chemistry* **2001**, *39*, 675-682.