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NOTE

Synthesis of Linear Poly(ethylene glycol) Derivatives Based on Tripodal

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A new and efficient method for the preparation of linear poly (ethylene glycol) derivatives based on tripodal is reported. In this method, six poly(ethylene glycol) derivatives have been synthesized in 85-92 % yields.

Key Words: Poly(ethylene glycol), Tripodal, Open-chained crown ether.

In recent years, the compounds with linear hydrophilic poly (ethylene glycol) have been widely used in super molecular chemistry, materials and organic synthesis[1-5]. The flexible chains could easily turn around, which could change to different configurations to adjust to the complex environment. Due to this property, these compounds are more convenient to complex with other guests. Furthermore, this ability of transform has some flexible property to encapsulate various guest molecules or ions and makes the inclusion, release, exchange of the guest groups much more easily[6]. Because of these properties of the flexible hosts, the complexions may have diversity structures; the sizes of caves could be adjusted and other unique properties that the rigid hosts do not have[7].

Polyethylene glycols (PEGs) can be regarded as the open-chained crown ether and have been used as salvation or phase transfer catalyst (PTC) in many organic reactions owing to their stability, low cost, environment friendliness and easy availability[8,9]. In many cases, they are good substitutes for the traditional phase transfer catalysts, such as the crown ether, which is toxic and expensive and quaternary ammonium salts or quaternary phosphonium compounds, which are predominantly used in the liquid-liquid two-phase reaction[10].

Because of the unique properties, the poly(ethylene glycol) derivatives have drawn increasing attention. Xu *et al.*[11] synthesized hyperbranched polyselenides with multi-catalytic sites of selenium located at the branching units, which provides a novel model for glutathione peroxidase (GPx) mimics. Northrop *et al.*[12] employed the polyethylene glycols (PEGs) as functionalized hydrophilic self-assembled supramolecular rectangles. Striegler and Gichinga[13] used the compound with poly(ethylene glycol) as a water-soluble pentadentate Schiff base backbone ligand to catalyticoxidation of catechols. Asakawa *et al.*[14] reported a serial of improved template-reagent including poly(ethylene glycols) to synthesis cyclobis (paraquat-*p*-phenylene).

Although many works have been done in this field, among most of the synthesized compounds, the polye(thylene glycols) (PEGs) are connected to the aromatic rings directly by phenol hydroxyl[15-17]. In this paper we wish to synthesize a new series of linear hydrophilic poly(ethylene glycol) derivatives based on tripodal which are connected directly by alcoholic hydroxyl. To the best of our knowledge, the structures of composing the poly(ethylene glycol) with the tripodal directly by alcoholic hydroxyl have not been studied thus far.

The poly(ethylene glycol), NaH and CH_2Cl_2 are available commercially without further purification. Solvents were dried according to standard procedures. The reaction were magnetically stirred and monitored by thin-layer chromatograph (TLC) using Huanghai GF_{254} silica gel-coated plates. ^1H and ^{13}C NMR spectra were measured using TMS as internal reference and $CDCl_3$ as solvent.

General procedures for the preparation: NaH (3.6 g, 9 mmol, 60 % in mineral oil) was added to a solution of poly (ethylene glycol) (9 mmol) in THF (90 mL) and stirred at the room temperature for 2.5 h and then tripodal (3 mmol, dissolved in 30 mL THF) was added to the mixture by drop wise. The reaction mixture was refluxed for 4 h. After the THF was evaporated under reduced pressure and dried, 100 mL water was added slowly and then, added 12 g EDTA·2Na. The mixture was also kept reflux for 5 h and extracted by CH_2Cl_2. The organic layer was washed with water and dried over anhydrous Na_2SO_4, filtered and concentrated. The crude

product should be purified by column chromatography ($CHCl_3$:CH_3OH = 10:1) to give the pure products.

For others, spectral data are given below, which are consistent with the assigned structures.

Compound 1: Light yellow liquid, yield: 92 %. ^{1}H NMR ($CDCl_3$, 300 MHz): δ = 2.38 (s, 3H, $ArCH_3$), δ = 3.31 (s, 3H, OCH_3), δ = 3.49 (t, 2H, CH_2), δ = 3.57 (t, 2H, CH_2), δ = 4.55 (s, 2H, $ArCH_2O$).

Compound 2: Light yellow liquid, yield: 91.3 %. ^{1}H NMR ($CDCl_3$, 300 MHZ): δ = 1.18 (t, 3H, CH_3), δ = 2.84 (q, 2H, CH_2), δ = 3.41 (s, 3H, OCH_3), δ = 3.56 (t, 2H, CH_2), δ = 3.68 (t, 2H, CH_2), δ = 4.56 (s, 2H, $ArCH_2O$).

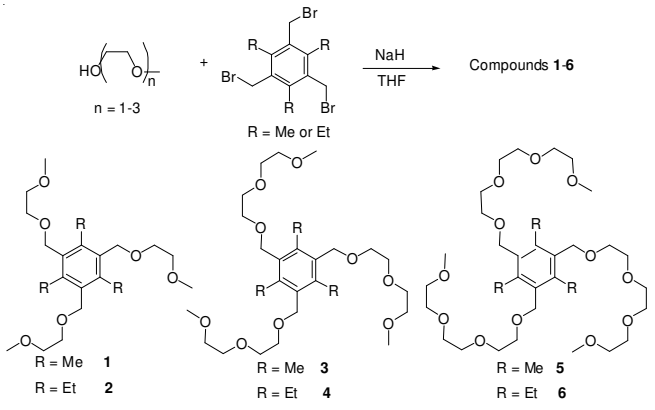
Compound 3: Light yellow liquid, yield: 90 %. ^{1}H NMR ($CDCl_3$, 300 MHZ): δ = 2.43 (s, 3H, $ArCH_3$), δ = 3.89 (s, 3H, OCH_3), δ = 3.56 (m, 4H, CH_2), δ = 3.65 (m, 4H, CH2), δ = 4.60 (s, 2H, $ArCH_2O$).

Compound 4: Light yellow liquid, yield: 89 %. ^{1}H NMR ($CDCl_3$, 300 MHZ): δ = 1.32 (t, 3H, CH_3), δ = 2.94 (q, 2H, CH_2), δ = 3.50 (s, 3H, OCH_3), δ = 3.66 (m, 4H, CH_2), δ = 3.83 (m, 2H, CH_2), δ = 4.69 (s, 2H, $ArCH_2O$).

Compound 5: Light yellow liquid, yield: 85 %. ^{1}H NMR ($CDCl_3$, 300 MHZ): δ = 2.41 (s, 3H, $ArCH_3$), δ = 3.37 (s, 3H, OCH_3), δ = 3.53 (m, 18H, CH_2), δ = 4.58 (s, 2H, $ArCH_2O$).

Compound 6: Light yellow liquid, yield: 87 %. ^{1}H NMR ($CDCl_3$, 300 MHZ): δ = 1.23 (t, 3H, CH_3), δ = 2.87 (q, 2H, CH_2), δ = 3.40 (s, 3H, OCH_3), δ = 3.57 (m, 18H, CH_2), δ = 4.57 (s, 2H, $ArCH_2O$).

Our synthesis route leading to the linear hydrophilic poly (ethylene glycol) derivatives based on tripodal are shown in **Scheme-I**.



Scheme-I

Tripodal was conveniently synthesized according to previously reported procedure[18]. The polyethylene glycols (PEGs) derivatives could be obtained by commercially available. The one thing that should be pointed out is that during the reaction procedure, we observed a new progress. When the reaction was completed, there was only one spot observed on the TLC on the bottom line, but after the THF was removed and treated the residue by water and EDTA·2Na for 5 h, a new spot appeared which was exactly the aim product. This phenomenon implied a truth that these types of compounds have strongly intended to complex with Na^+.

In summary, a practical route for the total synthesis of linear poly(ethylene glycol) derivatives based on tripodal has been developed. It started with a commercially available reagent and used Williamson reaction by one step to give an excellent yield (85-92 %). Works are continuing in our lab for the total synthesis of similar products and their potential use in the phase transfer catalyst and the complex properties.

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