Data Article

Data characterizing the biophysical and nitric oxide release properties of the tDodSNO – Styrene maleic anhydride nanoparticle SMA-tDodSNO

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A R T I C L E  I N F O

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A B S T R A C T

Nitric oxide (NO) donor drugs have a range of clinical applications, and are also being developed as therapeutics for the potential treatment of multiple diseases. This article presents data describing the synthesis and characterisation of a novel NO releasing nanoparticle formed by encapsulation of the NO donor tDodSNO into a co-polymer of styrene and maleic acid (SMA) to afford SMA-tDodSNO. The pharmacological activity of SMA-tDodSNO is discussed in our accompanying manuscript “Encapsulation of tDodSNO generates a photoactivated nitric oxide releasing nanoparticle for localized control of vasodilation and vascular hyper-permeability”. (Alimoradio et al. [1]).

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**Specifications table**

| Subject area                | Pharmacology                        |
|-----------------------------|-------------------------------------|
| More specific subject area  | Drug delivery                       |
| Type of data                | Table, photographs, figures, graphs, electronic spectra. |
| How data were acquired      | HPLC, Jenway 6715 UV–vis spectrometer, Malvern Zetasizer ZEN3600. |
| Data format                 | Analyzed.                           |
| Experimental factors        | For NO release, SMA-tDodSNO was photoactivated using a cold light source. |
| Experimental features       | Data reporting the loading of tDodSNO into SMA-tDodSNO; dynamic light scattering graphs showing the size and charge of the SMA-tDodSNO nanoparticles; photographs demonstrating the improved aqueous solubility of SMA-tDodSNO vs tDodSNO; electronic spectra characterizing NO release from SMA-tDodSNO. |
| Data source location        | University of Otago, Dunedin, New Zealand. |
| Data accessibility          | Data provided in article.           |
| Related research article    | Alimoradi, H., Barzegar-Fallah, A., Sammut, I.A., Griesh, K., and Giles, G.I. Encapsulation of tDodSNO Generates a Photoactivated Nitric Oxide Releasing Nanoparticle for Localized Control of Vasodilation and Vascular Hyperpermeability. Free Radic Biol Med, 2018, DOI: 10.1016/j.freeradbiomed.2018.10.433 [1]. |

**Value of the data**

- The data describe the synthesis, biophysical, and NO releasing characteristics of the novel nanoparticle SMA-tDodSNO, which can be used in further studies to explore the therapeutic potential of NO releasing drugs.
- The methodology described can be applied to generate and characterize new NO releasing nanoparticles.
- The NO release characteristics of SMA-tDodSNO can be used as a comparison to evaluate the activity of new NO donors.

1. **Data**

Following chemical synthesis, the yield of SMA-tDodSNO was obtained via weighing the product nanoparticle. The amount of tDodSNO in SMA-tDodSNO was then obtained by HPLC analysis, and nanoparticle loadings calculated according to theoretical yield calculations. SMA-tDodSNO solubility data were visually confirmed via photographs of tDodSNO and SMA-tDodSNO solutions. Nanoparticle biophysical characteristics were quantified by dynamic and electrophoretic light scattering of SMA-tDodSNO in deionized water. NO release from SMA-tDodSNO was measured by monitoring the oxidation of the protein oxymyoglobin via ultraviolet-visible spectroscopy, and analysis of the resulting spectra.

2. **Experimental design, materials and methods**

2.1. **Synthesis of tDodSNO**

tDodSNO was synthesized as previously described [2]. As a typical procedure, 2 ml of tert-dodecylmercaptan (11.32 mmol) were dissolved in 10 ml dry dichloromethane, and 1.5 ml of tert-butyl nitrite (11.33 mmol) added dropwise at 0 °C under argon. The mixture was stirred for 30 min, and then allowed to warm to ambient temperature and stirred for a further 30 min. The resulting...
mixture was evaporated under reduced pressure at 35 °C to obtain a dark green oil. The crude product was flash chromatographed on silica gel eluting with dichloromethane/hexane (3:97 v/v) to afford tDodSNO (2.48 g, 95% yield). Characteristic spectra were as previously reported [2].

2.2. Encapsulation of tDodSNO into SMA nanoparticles

Poly(styrene-co-maleic anhydride), SMA, was supplied by Sigma-Aldrich (St Louis, MO, USA). The co-polymer was cumene terminated, with a styrene: maleic anhydride feed ratio of 3:1, and an average Mn ~ 1600. To generate SMA-tDodSNO, nanoparticle formation was initiated using a previous method that has generic applicability for drug encapsulation within SMA [3]. Initially a SMA solution (10 mg/ml) was prepared by solubilizing 1 g of SMA powder in 100 ml of 1 M NaOH at 70 °C for 3 h. A 3.75 ml aliquot of this solution was cooled to 40 °C, and then acidified to pH 5.0 by the addition of 1 M HCl. tDodSNO (12.5 mg in 2 ml DMSO) was then added dropwise under continuous stirring (1300 rpm) to afford a cloudy solution, followed by the addition of 1-ethyl-3-(3-dimethylaminopropyl)carbodiimide (37.5 mg in 2 ml ddH2O). After stirring for 10 min, a further 10 ml ddH2O was added, the solution stirred for an additional 2 min, and the pH increased to 11 by the addition of 1 M NaOH. Once a clear green solution was obtained the pH was adjusted to 7.4 with 1 M HCl, and the resultant NP purified by 4 cycles of ultrafiltration with deionized water using an ultrafiltration system (Merck Millipore, Auckland, NZ) with a 10 kDa XL filter (Pellicon, Merck Millipore, Auckland, NZ), followed by

| SMA-tDodSNO theoretical maximum yield (mg) | SMA-tDodSNO experimental yield (mg) | Recovery (%) | tDodSNO loading (% w/w) |
|-------------------------------------------|-------------------------------------|--------------|--------------------------|
| 200                                       | 120.6                               | 60.3         | 20.1                     |
| 200                                       | 130.2                               | 65.1         | 22.6                     |
| 200                                       | 156.1                               | 78.0         | 20.4                     |
| Mean ± SD                                 | 135.6 ± 18.4                        | 67.8 ± 9.1   | 21.1 ± 1.4               |

Fig. 1. Solubility comparison between SMA-tDodSNO and tDodSNO. (A) SMA-tDodSNO (1 mM) in PBS. (B) tDodSNO (1 mM) in PBS.
lyophilization to afford a light green powder. To measure tDodSNO loading, known weights of SMA-tDodSNO were dissolved in methanol, and the concentration of tDodSNO quantified using HPLC [1]. tDodSNO loading was expressed as a w/w% of tDodSNO:SMA (Table 1).

2.3. Biophysical characterization of SMA-tDodSNO

Nanoparticle size and zeta potential were established by dynamic and electrophoretic light scattering of solutions of the nanoparticle in deionized water at room temperature using a Malvern Zetasizer ZEN3600 (Malvern Instruments Inc., Westborough, MA, USA). All measurements were repeated in triplicate.

SMA-tDodSNO fully dissolved in PBS at pH 7.4, while tDodSNO partitioned into an immiscible green layer (Fig. 1). The nanoparticle had a mean diameter of 230 ± 40 nm, with a polydispersity index of 0.21 ± 0.02 (Fig. 2). The surface charge of SMA-tDodSNO in ddH₂O was essentially neutral, with a mean Z-potential of −0.001 ± 0.032 mV (Fig. 2).

2.4. Quantification of NO release

Horse heart myoglobin was dissolved in phosphate buffer (pH 7.4), and then reduced by the addition of excess sodium dithionite for 5 min. The mixture was passed through a PD10 desalting column (Sephadex G-25M, GE Healthcare, Auckland, NZ) to purify and oxygenate the reduced myo-
globin to yield oxymyoglobin (MbO₂). MbO₂ concentration was determined by its electronic absorption at \( \lambda = 542 \text{ nm} \) \( (\epsilon = 13,900 \text{ M}^{-1} \text{ cm}^{-1}) \) \[4\]. As MbO₂ is sensitive to light \[5\], experiments were performed on ice. NO release from SMA-tDodSNO was quantified as previously described \[6\] using a cold light source for photoactivation \[1\] (Fig. 3).

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**Transparency document. Supporting information**

Transparency data associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2018.10.149.

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