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### Data Article

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



Houman Alimoradi<sup>a</sup>, Anita Barzegar-Fallah<sup>a</sup>, Ivan A. Sammut<sup>a</sup>,  
Khaled Greish<sup>b</sup>, Gregory I. Giles<sup>a,\*</sup>

<sup>a</sup> Department of Pharmacology and Toxicology, University of Otago, Dunedin, New Zealand

<sup>b</sup> College of Medicine and Medical Sciences, Department of Molecular Medicine and Nanomedicine Unit, Princess Al-Jawhara Center for Molecular Medicine and Inherited Disorders, Arabian Gulf University, Manama, Bahrain,

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#### ABSTRACT

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 hyperpermeability”. (Alimoradi et al. [1]).

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\* Corresponding author.

E-mail address: [gregory.giles@otago.ac.nz](mailto:gregory.giles@otago.ac.nz) (G.I. Giles).

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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. <i>Free Radic Biol Med</i> , 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 oxy-myoglobin 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

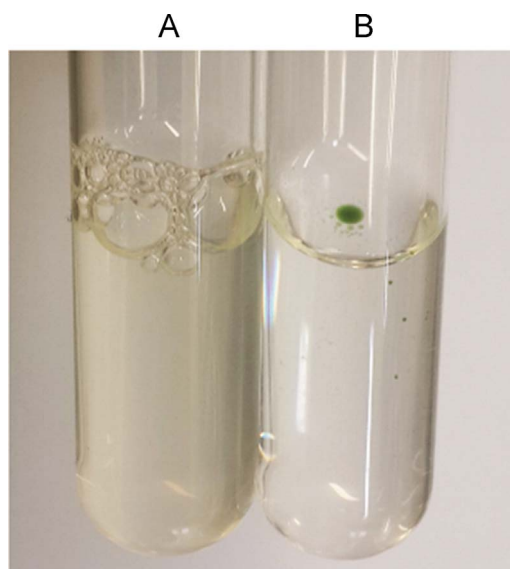
mixture was evaporated under reduced pressure at 35 °C to obtain a dark green oil. The crude product was flash chromatographed on silica gel eluting with dichloromethane/hexane (3:97 v/v) to afford tDodSNO (2.48 g, 95% yield). Characteristic spectra were as previously reported [2].

## 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  $M_n \sim 1600$ . 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 ddH<sub>2</sub>O). After stirring for 10 min, a further 10 ml ddH<sub>2</sub>O 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

**Table 1**  
SMA-tDodSNO loading.

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
<b>Mean ± SD</b>	<b>135.6 ± 18.4</b>	<b>67.8 ± 9.1</b>	<b>21.1 ± 1.4</b>



**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  $230 \pm 40$  nm, with a polydispersity index of  $0.21 \pm 0.02$  (Fig. 2). The surface charge of SMA-tDodSNO in ddH<sub>2</sub>O was essentially neutral, with a mean Z-potential of  $-0.001 \pm 0.032$  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-

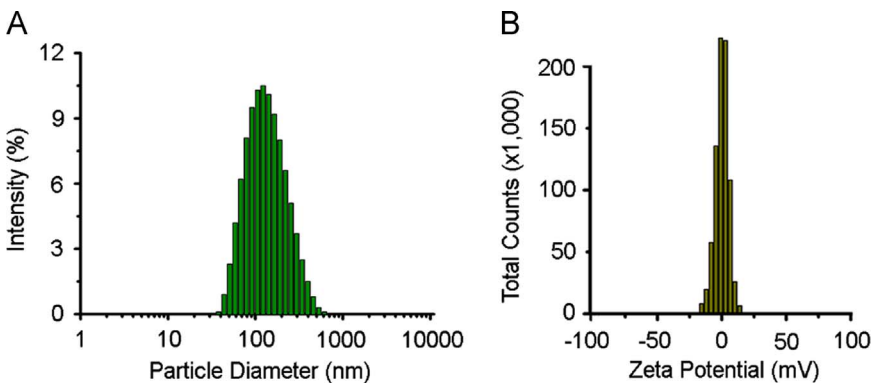


Fig. 2. Biophysical characteristics of SMA-tDodSNO. (A) Particle size distribution. (B) Zeta potential.

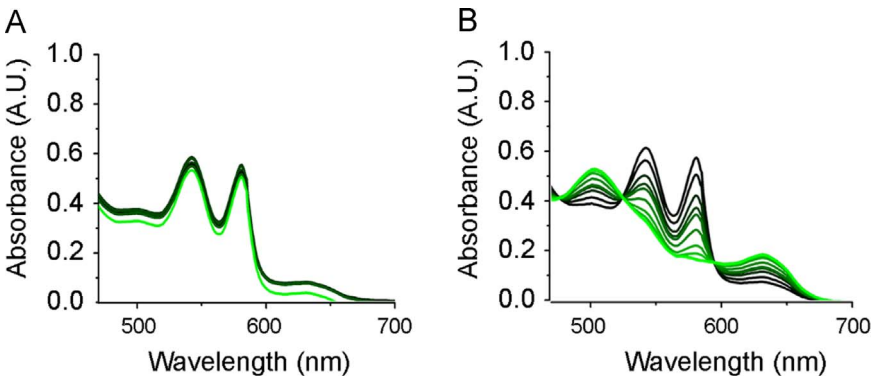


Fig. 3. Quantification of NO release from SMA-tDodSNO. SMA-tDodSNO ( $50 \mu\text{M}$ ) was added to MbO<sub>2</sub> ( $50 \mu\text{M}$ ) in PBS on ice, and electronic spectra of MbO<sub>2</sub> acquired over 30 min. A: Control conditions (no photoactivation), B: Photoactivation ( $2700 \text{ W/m}^2$ ). Overlaid spectra indicate the time course (black to green over 30 min) and the extent of oxidation of MbO<sub>2</sub> to met-myoglobin.

globin to yield oxymyoglobin (MbO<sub>2</sub>). MbO<sub>2</sub> concentration was determined by its electronic absorption at  $\lambda = 542 \text{ nm}$  ( $\epsilon = 13,900 \text{ M}^{-1} \text{ cm}^{-1}$ ) [4]. As MbO<sub>2</sub> 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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