

## Product Information

### Spermine tetrahydrochloride

Catalog Number **S2876**  
Store at Room Temperature

CAS RN: 306-67-2  
71-44-3 (free base)

Molecular Formula:  $C_{10}H_{26}N_4 \bullet 4HCl$   
Molecular Weight: 348.18

Synonym: N,N'-Bis(3-aminopropyl)-1,4-butanediamine tetrahydrochloride

Melting Point: 312 - 314.5 °C<sup>1</sup>

#### Product Description

Spermine is a naturally occurring polyamine that occurs in all eukaryotes, but is rare in prokaryotes. It is essential for cell growth in both normal and neoplastic tissue.<sup>1</sup> Spermine is formed through the addition of a aminopropyl group to spermidine by spermine synthase. Spermine is strongly basic in character, and in aqueous solution at physiological pH, all of its amino groups will be positively charged.<sup>2</sup> A review of the role of spermine and other polyamines in affecting RNA structure and protein function has been published.<sup>3</sup>

Spermine is commonly used in molecular biology and biochemistry research. The polycationic character of spermine in solution allows for its use in the precipitation of DNA of >100 base pairs in length from low salt aqueous buffers, and for the isolation of DNA from pulse field gels.<sup>4,5,6</sup> Spermine has also been utilized in chromosome isolation and in the aggregation of chromatin.<sup>7,8</sup> It may be used as a building block for the preparation of gene transfer agents.<sup>9,10</sup> The complexation of spermine with DNA to form particles with diameter <100 nm has been studied.<sup>11</sup> Spermine has been used in the crystallization of DNA.<sup>12,13</sup>

It has been reported that spermine interacts with the glycine binding site associated with the N-methyl-D-aspartate receptor complex.<sup>14</sup> Spermine has been shown to inhibit the conversion of L-arginine to L-citrulline by neuronal nitric oxide synthase in cytosolic preparations of rat cerebellum and cultured

cerebellar granule neurons.<sup>15</sup> In acute hippocampal slices, 1 mM spermine exerts a neuroprotective effect by blocking the NMDA receptor and voltage-activated  $Ca^{2+}$  channels.<sup>16</sup> The effect of spermine on MK-801 binding to recombinant N-methyl-D-aspartate receptors has been investigated.<sup>17</sup>

Proteins and protein complexes have been crystallized using spermine.<sup>18,19</sup> Other applications of spermine include its use as a matrix in MALDI-MS for analysis of glycoconjugates and oligonucleotides.<sup>20,21</sup>

#### Precautions and Disclaimer

This product is for R&D use only, not for drug, household, or other uses. Please consult the Material Safety Data Sheet for information regarding hazards and safe handling practices.

#### Preparation Instructions

This product is soluble in water (100 mg/ml), yielding a clear, colorless to light yellow solution.

#### Storage/Stability

Store at room temperature.  
Solutions of spermine free base are readily oxidized. Solutions are most stable if prepared in degassed water and stored in frozen aliquots, under argon or nitrogen gas.

#### References

1. The Merck Index, 14th ed., Entry# 8743.
2. Methods in Molecular Biology, Volume 79: Polyamine Protocols, Morgan, D. M. L., ed., Humana Press (Totowa, NJ: 1998), pp. 3-30.
3. Igarashi, K., and Kashiwagi, K., Polyamines: mysterious modulators of cellular functions. *Biochem. Biophys. Res. Commun.*, **271(3)**, 559-564 (2000).
4. Basic Methods in Molecular Biology, 2nd ed., Davis, L. G., et al., Appleton & Lang (Norwalk, CT: 1994), pp. 179-180.
5. Wallace, D. M., Precipitation of nucleic acids. *Methods Enzymol.*, **152**, 41-48 (1987).

6. Molecular Cloning: A Laboratory Manual, 3rd ed., Sambrook, J. and Russell, D. W., CSHL Press (Cold Spring Harbor, NY: 2001), pp. 5.86-5.88.
7. Cram, L. S., et al., Polyamine buffer for bivariate human flow cytogenetic analysis and sorting. *Methods Cell Biol.*, **33**, 377-382 (1990).
8. Marquet, R., et al., The condensation of chromatin and histone H1-depleted chromatin by spermine. *J. Biomol. Struct. Dyn.*, **4(2)**, 205-218 (1986).
9. Ronsin, G., et al., Novel spermine-based cationic gemini surfactants for gene delivery. *Chem. Commun. (Camb.)*, **21**, 2234-2235 (2001).
10. Azzam, T., et al., Polysaccharide-oligoamine based conjugates for gene delivery. *J. Med. Chem.*, **45(9)**, 1817-1824 (2002).
11. Trubetskoy, V. S., et al., The role of a microscopic colloiddally stabilized phase in solubilizing oligoamine-condensed DNA complexes. *Biophys. J.*, **84(2)**, 1124-1130 (2003).
12. Shui, X., et al., The B-DNA dodecamer at high resolution reveals a spine of water on sodium. *Biochemistry*, **37(23)**, 8341-8355 (1998).
13. Saminathan, M., et al., Polyamine structural effects on the induction and stabilization of liquid crystalline DNA: potential applications to DNA packaging, gene therapy and polyamine therapeutics. *Nucleic Acids Res.*, **30(17)**, 3722-3731 (2002).
14. Sacca, A. I., and Johnson, K. M., Spermine enhances binding to the glycine site associated with the N-methyl-D-aspartate receptor complex. *Mol. Pharmacol.*, **36(6)**, 836-839 (1989).
15. Hu, J., et al., Polyamines Inhibit Nitric Oxide Synthase in Rat Cerebellum. *Neurosci. Lett.*, **175(1-2)**, 41-45 (1994).
16. Ferchmin, P. A., et al., Spermine is neuroprotective against anoxia and N-methyl-D-aspartate in hippocampal slices. *Brain Res.*, **859(2)**, 273-279 (2000).
17. Sharma, T. A., and Reynolds, I. J., Characterization of the effects of polyamines on [<sup>125</sup>I]MK-801 binding to recombinant N-methyl-D-aspartate receptors. *J. Pharmacol. Exp. Ther.*, **289(2)**, 1041-1047 (1999).
18. Xie, X., et al., Coiled-coil packing in spermine-induced tropomyosin crystals. A comparative study of three forms. *J. Mol. Biol.*, **236(4)**, 1212-1226 (1994).
19. Qian, C., et al., A rational approach towards successful crystallization and crystal treatment of human cytomegalovirus protease and its inhibitor complex. *Acta Crystallogr. D Biol. Crystallogr.*, **56 (Pt 2)**, 175-180 (2000).
20. Mechref, Y., and Novotny, M. V., Matrix-assisted laser desorption/ionization mass spectrometry of acidic glycoconjugates facilitated by the use of spermine as a co-matrix. *J. Am. Soc. Mass Spectrom.*, **9(12)**, 1293-1302 (1998).
21. Asara, J. M., and Allison, J., Enhanced detection of oligonucleotides in UV MALDI MS using the tetraamine spermine as a matrix additive. *Anal. Chem.*, **71(14)**, 2866-2870 (1999).

RC,DF,PHC 05/09-1

Sigma brand products are sold through Sigma-Aldrich, Inc.

Sigma-Aldrich, Inc. warrants that its products conform to the information contained in this and other Sigma-Aldrich publications. Purchaser must determine the suitability of the product(s) for their particular use. Additional terms and conditions may apply. Please see reverse side of the invoice or packing slip.