

Review

Botulinum Neurotoxins (BoNTs) and Their Biological, Pharmacological, and Toxicological Issues: A Scoping Review

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Citation: Corsalini, M.; Inchingolo, F.; Dipalma, G.; Wegierska, A.E.; Charitos, I.A.; Potenza, M.A.; Scarano, A.; Lorusso, F.; Inchingolo, A.D.; Montagnani, M.; et al. Botulinum Neurotoxins (BoNTs) and Their Biological, Pharmacological, and Toxicological Issues: A Review. *Appl. Sci.* **2021**, *11*, 8849. <https://doi.org/10.3390/app11198849>

Academic Editor: Alfonso Zamboni

Received: 30 July 2021
Accepted: 18 September 2021
Published: 23 September 2021

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Abstract: Botulinum toxins or neurotoxins (BoNTs) are the most potent neurotoxins known, and are currently extensively studied, not only for their potential lethality, but also for their possible therapeutic and cosmetic uses. Currently, seven types of antigenically distinct toxins are known and characterized, produced by a rod-shaped bacterium, *Clostridium botulinum*. Human poisoning by botulism (presenting with severe neuromuscular paralytic disease) is usually caused by toxins A, B, E, and F type. Poisoning from contaminated food preparations is the most common cause of noniatrogenic botulism. The spores are highly resistant to heat but are easily destroyed at 80 °C for thirty minutes. Type A and B toxins are resistant to digestion by the enzymes of the gastrointestinal system. After their entry, BoNTs irreversibly bind to cholinergic nerve endings and block the release of acetylcholine from the synapses. In contrast, in wound botulism, the neurotoxin is instead produced by the growth of *C. botulinum* in infected tissues. The contamination by BoNT inhalation does not occur by a natural route but it is certainly the most dangerous. It can be caused by the dispersion of the botulinum toxin in the atmosphere in the form of an aerosol and therefore can be deliberately used for bioterrorist purposes (e.g., during CBRN (chemical, biological, radiological, and nuclear) unconventional events). In addition, BoNTs are currently used to treat a variety of diseases or alleviate their symptoms, such as the onabotulinumtoxinA for migraine attacks and for cosmetic use. Indeed, this paper aims to report on updated knowledge of BoNTs, both their toxicological mechanisms and their pharmacological action.

Keywords: botulinum toxins (BoNTs); *Clostridium C. Botulinum*; food poisoning; antidotes; toxicology; food intoxications; pharmacology; *C. Botulinum* toxins therapy; cosmetic medicine; CBRN (chemical, biological, radiological, and nuclear) events

1. Introduction

The *Clostridium* genus, a part of the phylum *Firmicutes*, belongs to the family *Clostridiaceae*, class *Clostridiales*, prokaryotic microorganisms and is sporogenic, Gram (+) bacteria, and anaerobic (even if some species can live in the microaerophilic environment

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Table of Contents Neurotoxins And Their Pharmacological Implications A Biological Council Symposium

1. Understanding the eBook Neurotoxins And Their Pharmacological Implications A Biological Council Symposium
 - The Rise of Digital Reading Neurotoxins And Their Pharmacological Implications A Biological Council Symposium
 - Advantages of eBooks Over Traditional Books
2. Identifying Neurotoxins And Their Pharmacological Implications A Biological Council Symposium
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Neurotoxins And Their Pharmacological Implications A Biological Council Symposium
 - User-Friendly Interface
4. Exploring eBook Recommendations from Neurotoxins And Their Pharmacological Implications A Biological Council Symposium
 - Personalized Recommendations

- Neurotoxins And Their Pharmacological Implications A Biological Council Symposium User Reviews and Ratings
- Neurotoxins And Their Pharmacological Implications A Biological Council Symposium and Bestseller Lists
- 5. Accessing Neurotoxins And Their Pharmacological Implications A Biological Council Symposium Free and Paid eBooks
 - Neurotoxins And Their Pharmacological Implications A Biological Council Symposium Public Domain eBooks
 - Neurotoxins And Their Pharmacological Implications A Biological Council Symposium eBook Subscription Services
 - Neurotoxins And Their Pharmacological Implications A Biological Council Symposium Budget-Friendly Options
- 6. Navigating Neurotoxins And Their Pharmacological Implications A Biological Council Symposium eBook Formats
 - ePub, PDF, MOBI, and More
 - Neurotoxins And Their Pharmacological Implications A Biological Council Symposium Compatibility with Devices
 - Neurotoxins And Their Pharmacological Implications A Biological Council Symposium Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Neurotoxins And Their Pharmacological Implications A Biological Council Symposium
 - Highlighting and Note-Taking Neurotoxins And Their Pharmacological Implications A Biological Council Symposium
 - Interactive Elements Neurotoxins And Their Pharmacological Implications A Biological Council Symposium
- 8. Staying Engaged with Neurotoxins And Their Pharmacological Implications A Biological Council Symposium
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Neurotoxins And Their Pharmacological Implications A Biological Council Symposium
- 9. Balancing eBooks and Physical Books Neurotoxins And Their Pharmacological Implications A Biological Council Symposium
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Neurotoxins And Their Pharmacological Implications A Biological Council Symposium
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions

- Managing Screen Time
- 11. Cultivating a Reading Routine Neurotoxins And Their Pharmacological Implications A Biological Council Symposium
 - Setting Reading Goals Neurotoxins And Their Pharmacological Implications A Biological Council Symposium
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Neurotoxins And Their Pharmacological Implications A Biological Council Symposium
 - Fact-Checking eBook Content of Neurotoxins And Their Pharmacological Implications A Biological Council Symposium
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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