EC PULMONOLOGY AND RESPIRATORY MEDICINE
Mini Review

The Application of Nanocarbon Onion-Like Fullerene (NOLF) Materials in the Human Respiratory System

Nicholas A Kerna[1]* and John V Flores[2,3]

[1]SMC–Medical Research, Thailand
[2]Beverly Hills Wellness Surgical Institute, USA
[3]Orange Partners Surgicenter, USA

***Corresponding Author:** Nicholas A Kerna, POB47 Phatphong, Suriwongse Road, Bangkok, Thailand 10500. Contact: medpublab+drkerna@gmail.com.

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Abstract

Since the 1980s, carbon fullerene materials have been investigated for medical applications in humans. Fullerene materials are composed of carbon atoms and are compatible with the human body. They reduce free radicals in cells, provide anti-inflammatory effects, and inhibit tumor growth in the body. However, the primary antioxidant benefit of fullerene materials might be through the activation of Nrf2. Fullerene materials do not interfere with lung surfactant lipids. They regulate the effects of free radicals in the respiratory systems of humans and animals reducing the formation of tumors in cells or tissues. However, nanocarbon onion-like fullerene materials' safety, manufacture, and dosage should be further evaluated and established for the therapeutic use in humans.

Keywords: *Duox Enzymes; Free Radical; Nanocarbon; Surfactant; Tumorigenicity*

Abbreviations

DNA: Deoxyribonucleic Acid; NOLF: Nanocarbon Onion-Like Fullerene; Nrf2: Nuclear Factor (Erythroid-derived 2) Factor 2; PDT: Photodynamic Therapy; RNA: Ribonucleic Acid; ROS: Reactive Oxygen Species

Introduction

Discovered in 1986, carbon fullerene materials triggered research of the into claims of their health benefits in the human body. Nanocarbon onion-like fullerene (NOLF) materials have been used in research by humans as they are compatible with the body. In several practical experiments, the fullerenes have proved to have life-extending and antioxidant effects in the human body. Through exposure to fullerenes, medical research has been conducted on humans regarding the effects of the materials in various physiological processes.

Based on the free-radical scavenging mechanism and synchronizing of various complex processes in the body—such as protein synthesis, metabolism, and cell division—fullerenes reduce free radicals in cells and provide anti-inflammatory effects, demonstrate tumorigenicity, and destroy tumors that may grow in the body [1]. The application of the materials *in vivo* continues to increase regarding the countering free radicals in cells and controlling the growth of tumors [2]. However, their the free-radical scavenging properties, although much lauded, are just one mechanistic benefit of NOLFs. According to Kovac *et al.* (2015), the primary antioxidant benefit of fullerene materials might be through the activation of the transcription of antioxidant master regulator nuclear factor (erythroid-derived 2) factor 2 (Nrf2) [3,4]. Pure forms of fullerene materials are widely used to produce anti-inflammatory effects and counter free radicals in cells with minimum contamination of tissues [5].

Discussion

The biocompatibility of nanocarbon onion-like fullerene (NOLF) materials

Fullerene materials are composed of carbon atoms, which make them compatible with the human body. Once in the human cells, fullerene molecules are broken down to the core due to the action of various enzymes and lysosomes [6]. As a result of prolonged inhalation, exposure, or dermal injection, the fullerenes are retained within the cells for extended periods resulting in evolutionary adaptation to the biophysiological processes. Also, due to the biocompatibility properties of the nanocarbon onion-like fullerenes materials in the body, the cells in the immune systems react with the new molecules. However, they do not result in significant responses in the body [7]. The homeostasis and coagulation processes improve with the fullerene carbon molecules, given their cell biocompatibility properties. Specifically, pristine fullerenes undergo addition reactions with molecules due to their high affinity for electrons acting as oxidizing agents and reducing radicals [8]. The pristine fullerene atoms remain stable in the body and do not interfere with biological processes. Fullerene materials are used in the treatment of tumors due to their chemical structure and biocompatibility properties when introduced to human cells.

Antitumor properties of nanocarbon onion-like fullerene molecules

When exposed to white light, the nanocarbon onion-like fullerene molecules absorb photon energy from the ultraviolet band. When the molecules are exposed to light, fullerene undergoes excitation from its singlet to triplet state in the form of quantum reactions, where electrons shift from one shell to another [9]. Consequently, the excitation of the fullerene molecules results in the rise of reactive oxygen species (ROS) reactions in the body over time. The introduction of fullerene excitation in the body induces repair reactions in the epithelium, where uracil is produced in the intestine. Subsequently, the Duox enzymes, produced in the intestines, result in damage to bacteria that may attack the deoxyribonucleic acid (DNA), proteins, and the ribonucleic acid (RNA) in the body. Carbon fullerenes are applied in photodynamic therapy (PDT) to destroy malignant tissues or tumors [10]. The fullerene materials are induced under exposure to the light energy to trigger the cells' ROS reactions to destroy malignant cells in the body. However, the fullerenes' actions in eliminating body tumors are governed within their cellular oxidative reaction limits to avoid damage to biological processes [2,4]. As a result, the production of carbon fullerenes to be used in destroying tumors in the body should be regulated and evaluated for biocompatibility and reducing toxicity to cells.

Longevity benefits associated with fullerenes

One of the actions of fullerenes in the body is the free-radical scavenging mechanism, where biological processes are not interfered with as the materials adopt biological functions. The nanocarbon fullerenes act as antioxidants that protect body cells from the free radicals produced during cell metabolic processes [11]. In *in vivo* medical research, the nanocarbon fullerene molecules have been found to be compatible with cell metabolism, producing anti-inflammatory effects and reducing tumorigenicity [12]. Pure forms of pristine fullerene molecules, with uniform catenation in their structure, are often produced for such experiments, eliminating contamination of the cells involved. Through laboratory evaluation of these materials, the cellular adaptation and longevity benefits associated with fullerenes can be achieved in humans and animals [13].

Fullerene materials and the respiratory system

In respiratory systems, the fullerene materials do not interfere with lung surfactant lipids, which reinforces their biocompatibility in humans. Nanocarbon fullerene materials in the lungs are typically phagocytized by immune cells reducing fibrotic changes in the lungs. As a result, these materials regulate the effects of free radicals in the respiratory systems of humans and animals to reduce the formation of tumors in cells or tissues. Also, due to their properties, nanocarbon fullerenes are maintained at pure levels to avoid the destruction of cells and interference of cellular mechanisms in humans and animals [7].

Pristine fullerene materials' safety should be established before intoduction into the human body. Moreover, the action of carbon fullerenes *in vivo* can be used for intensive medical research in humans since the materials display biological compatibility in various cell environments [14]. The studies conducted on human subjects confirmed the safety of the pristine fullerene materials when the length and degree of exposure were controlled. However, batch consistency, dosage, and toxicity remain barriers to NOLF materials research in the therapeutic application of nanocarbon onion-like fullerene materials [15].

Conclusion

Nanocarbon onion-like fullerene materials seem to elicit biological benefits in human bodies when introduced in safe amounts or limited exposure. These materials are purported to induce longevity and anti-inflammatory effects in cells without interference to cellular mechanisms in the body. Fullerene materials have biocompatibility properties in various media wherein their molecules do not interfere with biological mechanisms. The application of NOLF materials counters free radicals in cells and limits the growth of tumors. The free-radical scavenging properties of NOLFs are commonly reported. Nonetheless, the activation of the transcription of antioxidant master regulator Nrf2 is crucial in mediating protection against oxidants. Nanocarbon onion-like fullerene materials do not interfere with lung surfactant lipids and help reduce fibrotic changes and inhibit tumor formation in the lungs.

Further research on the potential beneficial effects and possible adverse effects of fullerene materials in human cells or tissues should be conducted to confirm or deny any medical advantages associated with their chemical structures and properties.

Conflict of Interest Statement

The authors declare that this paper was written in the absence of any commercial or financial relationship that could be construed as a potential conflict of interest.

Supplementary Note

This paper, as a mini-review, is designed as a brief introduction to nanocarbon onion-like fullerenes (NOLFs), regarding their application in pulmonary medicine. Other articles have been or will be published on the application of NOLFs in the cardiovascular system, gastrointestinal system, neurological system, veterinary medicine, agriculture, pharmacology and toxicology, and other topics. These distinct mini-review articles could have been combined into a much lengthier review or research article. However, to have done so, the subject matter would have resulted in only one publication in one journal, to the exclusion of other medical specialties. The purpose of these papers is to disseminate the purported biocompatibility and beneficial effects of NOLFs and variegated fullerene materials to the broadest audience of students, researchers, and medical practitioners as possible. The authors hope that the introduction to the application of fullerene materials in various and diverse disciplines spawns curiosity and further research regarding these extraordinary substances. Fullerene materials seem poised to become a vital part of the future of medicine, veterinary medicine, and agriculture. However, more research is needed to determine any adverse effects of their long-term use. Also, the NOLF manufacturing process requires standardization to provide consistent quality and batch samples. Dosage and duration of treatment with fullerene materials for specific conditions need to be established by evidence-based research.

References

1. Lynch I., *et al.* "Protein-nanoparticle interactions: What does the cell see?" *Nature Nanotechnology* 4 (2009): 546-547. https://pubmed.ncbi.nlm.nih.gov/19734922/

2. Lee HM., *et al.* "Nanoparticles up-regulate tumor necrosis factor-α and cxcl8 via reactive oxygen species and mitogen-activated protein kinase activation". *Toxicology and Applied Pharmacology* 238 (2009): 160-169. https://pubmed.ncbi.nlm.nih.gov/19450615/

3. Kovac S., *et al*. "Nrf2 regulates ROS production by mitochondria and NADPHoxidase". *Biochimica et Biophysica Acta (BBA)-General Subjects* 1850.4 (2015): 794-801. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4471129/

4. Rodriguez D, Bethencourt A, Ortet D, Kerna NA. "The Protective Effect of Nrf2 Activation in Cardiovascular Disease". EC Cardiology 6.11 (2019): 78-82

5. Najla Gharbi., *et al*. "[60] Fullerene is a Powerful Antioxidant in Vivo with No Acute or Subacute Toxicity". *Nano Letters* 5.12 (2005): 2578-2585. https://pubmed.ncbi.nlm.nih.gov/16351219/

6. Grande T., *et al*. "Preparation of chitosan/poly (vinyl alcohol) nanocompositefilmsincorporated with oxidized carbon nano-onions (multi-layerfullerenes) for tissue-engineering applications". *Biomolecules* 9.11 (2019): 684. https://pubmed.ncbi.nlm.nih.gov/31683889/

7. Bourassa DJ and Kerna NA. Pristine. Nanocarbonbased Fullerene-like Material Toxicity and Biocompatibility (Part 2 in the series: Will Nanocarbon Onion-Like Fullerenes Play a Decisive Role in the Future of Molecular Medicine?). Determinations Nanomed Nanotechnol.1(1). DNN.000504.2019.

8. Bourassa DJ, Kerna NA, Desantis M. A Retrospective Investigation of Novel Catenated Multi-shelled Fullerene-like Material for Biocompatibility after Prolonged Inhalation, Dermal, and Ingestion Exposure in Human Subjects. Part 3 in a series: Will Nanocarbon Onion-Like Fullerenes (NOLFs) Play a Decisive Role in the Future of Molecular Medicine? EC Pharmacology and Toxicology. 2019 Jun 2; 7.7: 577–584.

9. Song XN., *et al*. "Theoretical study of nano onion-like fullerenes C20@ C80 on XPS and NEXAFS spectra". *Molecular Physics* 117.6 (2019): 794-803. https://www.tandfonline.com/doi/abs/10.1080/00268976.2018.1542167?journalCode=tmph20

10. Mykhailiv O., *et al*. "Carbon nano-onions: Unique carbon nanostructures with fascinating properties and their potentialapplications". *Inorganica Chimica Acta* 468 (2017): 49-66. https://www.sciencedirect.com/science/article/abs/pii/S0020169317302426

11. Bourassa DJ and Kerna NA. "Foundation in Fullerenes: Theoretical Application of NOLFs in the Quantum Cell". *Journal of Nanoscience and Nanomedicine JNAN* (2018): 152.

12. Salata OV. "Applications of nanoparticles in biology and medicine". *Journal of Nanobiotechnology* (2004): 2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC419715/

13. D'Ambra M., *et al*. "Biocompatibility and biodistribution of functionalized carbon nano-onions (f-CNOs) in a vertebrate model". *Scientific Reports* 6.1 (2016): 1-9. https://www.nature.com/articles/srep33923

14. Giordani S., *et al*. "Carbon nano-onions: a valuable class of carbon nanomaterials in biomedicine". *Current Medicinal Chemistry* 26.38 (2019): 6915-6929. https://pubmed.ncbi.nlm.nih.gov/30474524/

15. Shvedova AA., *et al*. "Mechanisms of carbon nanotube-induced toxicity: Focus on oxidative stress". *Toxicology and Applied Pharmacology* 261 (2012): 121-133. https://www.sciencedirect.com/science/article/pii/S0041008X12001263

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