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Opinion

# Pharmaceutical Potential of Cerium Oxide Nanoparticles as Anti-Obesity and Anti-Diabetic Nano-Drug

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## Opinion

Obesity is a universal pathological condition that affected human health seriously. It would be better to say that, treatment methods of obesity have not been effective to date [1]. This problem evoke researchers into a great challenge to overcome it [2]. Broadly speaking, the reactive oxygen species (ROS) play an important role in lipid accumulation [3]. Oxidative stress is an indispensable phenomenon for the adipocyte accumulation [4-6]. Diabetes mellitus (DM) is an endocrine-metabolic disorder that is increasing worldwide due to population aging, urbanization and obesity. Above all, it causes accelerate mortality rate. Increased oxidative stress plays an important role in the development and progression of diabetes and its complications. Diabetes is usually caused by increased production of free radicals or impaired antioxidant defense [7]. Lorcaserin is a serotonin 5-HT2C receptor agonist which imitate from the serotonin effects and causing an increase of satiety and the reduction of the appetite [8]. Qsymia is a combination of the two drugs phentermine and topiramate, which has the role of weight loss by suppressing the appetite and increasing the sense of satiety [9]. It is also worth mentioning that both of these drugs show considerably side effects like dizziness, headache, insomnia, and risk of teratogenicity [10]. Another strategy to decrease body weight is the assumption of dietary polyphenols (such as green tea, resveratrol, curcumin, etc.), that exhibit antioxidant and anti-inflammatory effects related to lipid accumulation [11], but unfortunately, they are rapidly metabolized by enzymes. As a matter of fact they have low stability and bioavailability after the ingestion [12].

**Table 1:** chemical properties and clinical application of CONPs.

| Chemical name / Abbreviation | Formula | Molar Mass | Density | Melting Point | Crystal structure: | Solubility in water |
|---|---|---|---|---|---|---|
| Cerium oxide nanoparticles and nanoceria / CONPs | $CeO_2$ | 172.115 g/mol | 7.22 g/cm$^3$ | 2,400 °C | Cubic (fluorite) | Insoluble |
| **Applications** | | | | | | **References** |
| 1. Radioprotector | | | | | | (19-22) |
| 2. Retinal neurodegeneration protection | | | | | | 23 |
| 3. Anti-inflammatory | | | | | | 23 |
| 4. Antioxidant | | | | | | (19, 23) |
| 5. Neuroprotective | | | | | | 24 |

Beneficial effects of cerium oxide nanoparticles (CONPs - CeO2) or nanoceria cover a wide area of applications, ranging from macular degeneration to cancer therapy which listed in Table 1 [13]. CONPs mimic superoxide dismutase and/or catalase activity, depending on the presence of crystalline defects on their surface (Ce3+/Ce4+ ratio) and the environment pH where they accumulate [14]. Nanoceria as Reactive Oxygen Species (ROS) scavenger can self-regenerate their antioxidant properties by switch between the two oxidation states of cerium [15]. Thereby cerium oxide nanoparticles could overcome most of the typical limitations of traditional anti-oxidant agents because of the self-regenerating catalytic properties. Conversely to commercially available drugs against obesity, CONPs have useful advantage to strongly scavenge the ROS production for a long-sustained period of time, thus for one thing it reduces the needed doses and eventually diminish the adverse side effects of other drugs [1]. Strategies to reduce the formation of oxidative stress are important in the treatment of DM [16]. It seems that $CeO_2$ nanoparticles as powerful antioxidant with free radical scavenging properties, is suitable for this purpose [17]. CONPs were thought to increase antioxidant power due to their catalytic effect in stimulating superoxide Dismutase (SOD) activity and detoxifying free radicals by staying active in the tissues for a long time through the spontaneously movement between the oxidized and reduced state [18-24]. It was shown in animal model that CONPs could reduce body weight effectively [1]. These promising results may provide a novel treatment in the clinical setting in the future. Bearing in mind that future studies should scrutinize the biocompatibility and bioactivity mechanism of the CONPs in diabetic patients.

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