List of important contributions by the applicant

1. Jeevanandam, J., Chan, Y. S., Danquah, M. K., & Law, M. C. (2020). **Cytotoxicity analysis of morphologically different sol-gel-synthesized MgO nanoparticles and their in vitro insulin resistance reversal ability in adipose cells.** *Applied biochemistry and biotechnology*, *190*(4), 1385-1410.

Highlights: This is the first ever reported nanoparticle that can reverse insulin resistance. The concept of magnesium supplement via MgO nanoparticles to reverse insulin resistance for the treatment of diabetes has been hypothesized by the applicant (in his earlier review article), which was proven by this research article. The study showed that the chemical synthesized MgO nanoparticles via sol-gel approach with distinct morphologies, such as spherical, hexagon and rod are less toxic to normal cells and diabetic cells. Further, the study showed that the hexagon shaped nanoparticles are less/non toxic towards diabetic cells, compared to other shapes. The hexagonal shaped MgO nanoparticles has been identified to reverse insulin resistance and reduce glucose levels in diabetic cells within 24 h.

2. Jeevanandam, J., Chan, Y. S., & Danquah, M. K. (2020). **Cytotoxicity and insulin resistance reversal ability of biofunctional phytosynthesized MgO nanoparticles.** *3 Biotech*, *10*(11), 489.

Highlights: This work investigated the cytotoxicity of hexagonal MgO nanoparticles synthesized via *Amaranthus tricolor* leaf extract and spherical MgO nanoparticles synthesized via *Amaranthus blitum* and *Andrographis paniculata* leaf extracts. In vitro cytotoxicity analysis showed that the hexagonal MgO nanoparticles synthesized from *A. tricolor* extract demonstrated the least toxicity to both diabetic and non-diabetic cells at 600 µl/ml dosage. The viability of the diabetic cells (3T3-L1) after incubation with varying dosages of MgO nanoparticles was observed to be 55.3%. Colorimetric glucose assay revealed that the *A. tricolor* extract synthesized MgO nanoparticles resulted in ~ 28% insulin resistance reversal. It was inferred that the synergistic effect of the phytochemicals and MgO nanoparticles played a significant role in delivering enhanced insulin resistance reversal capability in adipose cells. The study also revealed that the biosynthesized nanoparticles are less toxic, compared to chemical synthesized MgO nanoparticles.

3. Tan, K. X., Jeevanandam, J., Pan, S., Yon, L. S., & Danquah, M. K. (2020). **Aptamer-navigated copolymeric drug carrier system for in vitro delivery of MgO nanoparticles as insulin resistance reversal drug candidate in Type 2 diabetes.** *Journal of Drug Delivery Science and Technology*, *57*, 101764.

Highlights: This work reported the synthesis of a multifunctional aptamer-navigated particulate delivery system (DPAP), harboring MgO (synthesized via chemical - MgO_1 and green – MgO_2 approaches) nanoparticles, to target 3T3-L1 diabetic cells. *In vitro* performance indicators, including encapsulation efficiency, targeting capability, cellular transfection efficiency, and insulin reversal capacity, were investigated. DPAP-MgO_2 offered better encapsulation efficiency and loading capacity of 93.69% and 0.03 mg MgO/mg PLGA, respectively. 3,5-Dinitrosalicylic acid (DNS) assessment showed that both DPAP-MgO_1 and DPAP-MgO_2 particulate systems enhanced the *in vitro* cellular uptake, as well as the insulin resistance reversal ability of the 3T3-L1 cells. The outcomes from the study demonstrated the potential of DPAP particulate system as an effective and promising carrier, for the delivery of MgO nanoparticles in diabetes treatment.

4. Jeevanandam, J., Chan, Y. S., & Danquah, M. K. (2017). **Calcination-dependent morphology transformation of sol-gel-synthesized MgO nanoparticles**. *ChemistrySelect*, *2*(32), 10393-10404.

Highlights: This study investigated the effect of sol-gel synthesis conditions on the shape and size as well as other functional features of MgO nanoparticles. The results demonstrated that the size and

shape alterations of MgO nanoparticles were dependent on changes in calcination temperature and also the presence of periclase phase along with their crystallinity and functional groups. TEM analysis showed the morphological evolution during the synthesis process from spherical to hexagonal and from hexagonal to rod shape. By varying the calcination temperature and gelling agent composition in sol-gel synthesis, MgO nanoparticles with different size distributions and morphologies can be generated for various applications. This work revealed that the gelling agent is responsible for sol-gel phase formation which eventually affects the calcination temperature for the formation of morphologically different MgO nanoparticles to be beneficial for pharmaceutical applications.

5. Jeevanandam, J., San Chan, Y., & Danquah, M. K. (2017). **Biosynthesis and characterization of MgO nanoparticles from plant extracts via induced molecular nucleation**. *New Journal of Chemistry*, *41*(7), 2800-2814.

Highlights: In this study, leaf extracts from three different plants: *Amaranthus tricolor*, *Andrographis paniculata* and *Amaranthus blitum* were used for the synthesis of magnesium oxide (MgO) nanoparticles. The TEM results showed that all the samples demonstrated stability with a particulate size range of 18–80 nm. The process of smaller MgO nanoparticle formation due to utilization of different precursors and leaf extracts was also explained. Overall, the green synthesis approach demonstrated potential for developing highly stable MgO nanoparticles with tight particle size distribution from different plant materials for applications in biosensing and therapeutic development.

6. Jeevanandam, J., Chan, Y. S., & Ku, Y. H. (2018). **Aqueous Eucalyptus globulus leaf extract-mediated biosynthesis of MgO nanorods**. *Applied Biological Chemistry*, *61*(2), 197-208.

Highlights: In this study, MgO nanorods (MgONRs) are synthesized using *Eucalyptus globulus* aqueous leaf extract. The results are highly significant as rod-shaped nanoparticles possess superior cellular penetration ability than other morphologies and can be valuable in medical applications. The transmission electron microscope analysis showed that the optimized parameters yield 6–8 nm width of stacked MgONRs. Thus, the present work demonstrated a simple and rapid biosynthesis route for MgO nanorod synthesis which can be beneficial in biosensing and therapeutic application. This is the first study to report rod shaped nanoparticles with phytochemicals extracted from plants.

7. Siaw, Y. M., Jeevanandam, J., Hii, Y. S., & Chan, Y. S. (2020). **Photo-irradiation coupled biosynthesis of magnesium oxide nanoparticles for antibacterial application.** *Naunyn-Schmiedeberg's archives of pharmacology*, *393*(12), 2253-2264.

Highlights: This study showed the synthesis of MgO nanoparticles using leaf extracts of *Amaranthus tricolor* and photo-irradiation of visible light as a catalyst, without addition of any chemicals. This is the first work to synthesize MgO nanoparticles with visible light as a potential catalyst. The experiment performed with optimized conditions such as 0.001 M concentration of magnesium acetate as precursor, 5 cm distance of light (intensity), and 15 min of reaction time (light exposure) has led to the formation of 74.6 nm sized MgO nanoparticles. The results revealed that the antibacterial activity of MgO nanoparticles from both biosynthesis approaches was similar. Thus, photo-irradiated MgO nanoparticles were beneficial, compared to heat-mediated conventional method due to the reduced synthesis duration.

8. Thamilvanan, D., Jeevanandam, J., Hii, Y. S., & Chan, Y. S. (2021). **Sol-gel coupled ultrasound synthesis of photo-activated magnesium oxide nanoparticles: Optimization and antibacterial studies**. *The Canadian Journal of Chemical Engineering*, *99*(2), 502-518.

Highlights: This work reported the optimization and antibacterial studies of sol-gel coupled

ultrasound synthesis of photo-activated magnesium oxide (MgO) nanoparticles. This study confirms the ability of MgO nanoparticle as an alternate and better antibacterial agent via photo-activation for the first time. These photo-activated MgO nanoparticles will be beneficial in the possible inhibition of bacterial growth in surgical equipment, lab coats, or even as antibacterial paints in hospitals.

9. Mudali, D., Jeevanandam, J., & Danquah, M. K. (2020). **Probing the characteristics and biofunctional effects of disease-affected cells and drug response via machine learning applications**. *Critical reviews in biotechnology*, *40*(7), 951-977.

Highlights: This article provides an account for the use of machine learning methods to probe differences in the biophysical, biochemical and physiological characteristics of infected cells in response to pharmacokinetics uptake of drug ingredients for application in cancer, diabetes and neurodegenerative disease therapies. In this work, we have worked with a computation biologist to reveal the ability of machine learning in the early diagnosis of diseases.

10. Jeevanandam, J., Gonçalves, M., Castro, R., Gallo, J., Bañobre-López, M., & Rodrigues, J. (2023). **Enhanced alpha-amylase inhibition activity of amine-terminated PAMAM dendrimer stabilized pure copper-doped magnesium oxide nanoparticles**. *Biomaterials Advances*, 213535.

The work showed the preparation of copper-doped MgO nanoparticles via a sol-gel approach and study their antidiabetic alpha-amylase inhibition activity with undoped MgO nanoparticles. The ability of G5 amine-terminated polyamidoamine (PAMAM) dendrimer for the controlled release of copper-doped MgO nanoparticles to exhibit alpha-amylase inhibition activity was also evaluated. The amylase inhibition assay emphasized that the dendrimer nanoparticles stabilization has led to the prolonged enzyme inhibition ability of MgO and copper-doped MgO nanoparticles for up to 24 h. This is a pioneer work to utilized dendrimer based formulation to release copper doped MgO nanoparticles for alpha-amylase inhibition activity.