Universiti Malaysia Perlis

INVENTORS

ENGR. DR. MIDHAT NABIL AHMAD SALIMI
ADILAH ANUAR

CONTACT DETAILS

School of Bioprocess Engineering
Universiti Malaysia Perlis
Jejawi 02600, Perlis
MALAYSIA
Tel : +6(04) 979 8513
Fax : +6(04) 979 8755
e-mail : nabil@unimap.edu.my
www.unimap.edu.my/bioprocess

NOVEL HYDOXYAPATITE (HAp) NANOPARTICLES PRODUCTION BY SUPERCRITICAL CARBON DIOXIDE PROCESSING FOR DRUG DELIVERY APPLICATION (POTENTIAL FOR VARIOUS CANCER TREATMENTS)

Patent No.: PT/4614/UNIMAP/13

INTRODUCTION

Drug Delivery

- Systems for transporting a pharmaceutical compound in the body as needed to safely achieve its desired therapeutic effect.
- It may involve scientific site-targeting within the body, or it might involve faciiitating systemic pharmacokinetics; in any case, it is typically concerned with both quantity and duration of drug presence.
- Drug delivery is often approached via a drug's chemical formulation, but it may also involve medical devices or drug-device combination products.

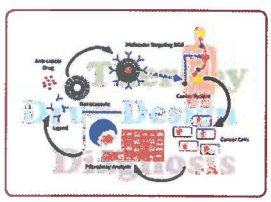

Figure 1: An example of drug delivery application in treating a patient with cancer.

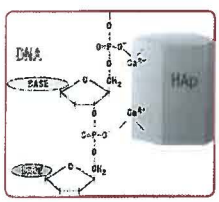

Figure 2: Schematic model of an affinity binding between a nHAp crystal and DNA.

PRODUCT DESCRIPTIONS

- Nanocrystalline hydroxyapatite, nHAp (a calcium phosphate based material) has performed particularly well for this matter.
- nHAp is biocompatible, biodegradable & non-toxicity to cells.
- It also provides nucleic acid protection from nucleases within the cells.
- The cellular uptake mechanism of these promising nanoparticles is by endocytosis (engulfing them via the cell membrane).

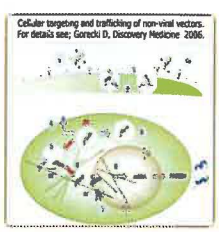

Figure 3: Mechanism of cellular uptake of non-viral drug delivery vectors (via endocytosis).

NOVELTIES

- When precipitated in aqueous solutions, the nHAp crystals tend to agglomerate.
- Therefore, accelerated removal of the solvent using supercritical carbon dioxide ($scCO_2$) processing would result in rapid supersaturation of the solution, causing immediate precipitation of the product in powder form, with little time for growth and agglomeration to occur.
- Suitable substitute for common organic solvents which are normally toxic & harmful, hence being coined the term 'green' technology.

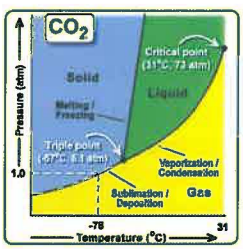

Figure 4: CO_2 pressure-temperature phase diagram.

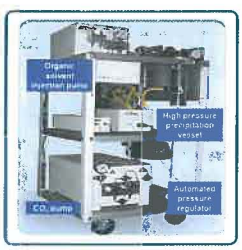

Figure 5: A supercritical carbon dioxide processing rig.

PROCESS DESCRIPTIONS

Parameter	Data
• Supercritical CO_2 processing method	• Solution Enhanced Dispersion of Supercritical Fluids (SEDS)
• Solvent used	• Dimethyl sulfoxide (DMSO)
• Temperature	• 50 °C
• Pressure	• 150 bar

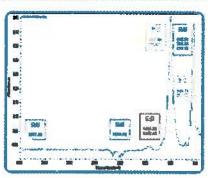

Figure 6: FTIR spectra of supercritical processed nHAp.

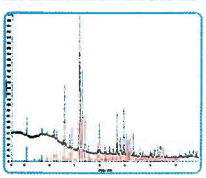

Figure 7: XRD pattern of supercritical processed nHAp.

Figure 8: TEM images of supercritical processed nHAp.

Figure 9: Endocytosis of nHAp incubated with PicoGreen® labelled DNA and monitored by fluorescence and optical light microscopy.

COMMERCIAL POTENTIAL

- In medical field, more specifically in drug delivery application.
- This inorganic biomaterial has the potential for treating various types of cancer.

COLLABORATION / FUNDING BODY

Collaborative project between Universiti Malaysia Perlis (UniMAP), Malaysian Ministry of Education and University of Birmingham, United Kingdom.

PUBLICATIONS

M. Nabil Salimi, Rachel H. Bridson, Liam M. Grover and Gary A. Leeke (2012), *'Effect of Processing Conditions on the Formation of Hydroxyapatite Nanoparticles'*, Journal of Powder Technology – An International Journal on the Science and Technology of Wet and Dry Particulate Systems, Powder Technology 218 (2012) 109 – 118.

M. N. Salimi and A. Anuar (2013), *'Characterization of biocompatible and bioactive hydroxyapatite particles'*, Procedia Engineering (Scopus Indexed) Volume 53 (2013) 192 - 198.