

Versatile sporopollenin exine microcapsules (SpECs) from *Lycopodium clavatum* L.spores as protection and delivery vehicles and building blocks for new bio-composites

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Lycopodium clavatum spores are a bulk commodity used in such as herbal remedies and pyrotechnics. In recent years there has been increasing interest to form microcapsules (SpECs) by evacuating the cytoplasmic contents[1]. The outer shell of SpECs is composed of sporopollenin, which is a highly stable polymer due to the high-level of crosslinking of constituent lipophilic units. The polymer possesses conjugated phenolic groups that shield the contents against UV-light and carboxylic acid groups, which offer flexibility for derivatization and modifying polarity characteristics[2]. These protective properties, along with the elasticity of SpECs, have found application in decorative cosmetics (under licence from Sporomex since 2012 [3]). Furthermore, SpECs can help protect and deliver active compounds when taken orally. An additional and major advantage is that SpECs can enhance bioavailability in human volunteers, *via* the oral route, for encapsulated vitamin D and eicosapentaenoic acid (EPA) respectively, *versus* when they were administered in free form [4]. SpECs have also proved advantageous for use in delivering immunocontraceptives in conjunction with trimethyl chitosan (TMC) nanoparticles *via* the oral route in rats, *versus* when TMC-immunocontraceptive conjugates are administered alone [5]. Other nanoparticles investigated were those produced from starch.

We have shown that SpECs can also be used as building blocks to construct new types of porous bioconjugates in which such as live yeast cells can be housed, protected, and shown to function efficiently [6].

References

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- [6] *Exine Construct* patent US 20240139335 (18/278,897)

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BIO

Obtained PhD, under the direction of Professor Gordon Shaw at the University of Bradford in 1976. SRC/University of Bradford Research Fellow, Visiting Investigator at the Sloan Kettering Cancer Research Institute NYC (1979), Senior Lecturer, Lincoln University Humberside Polytechnic (now Lincoln of University) (1982-1990), CNRS Poste Rouge, Director of Research at University of Lyon, France (1988-1989), Visiting Professorship at University of Hokkaido, (1989), Reader in Bioorganic Chemistry at University of Hull (1990-2017), Visiting Professorships at: Picardie Jules Verne (1992-2005), Artois (2005-2010) and Limoges (2006-2007), Technical Director, Sporomex Ltd (2002-date), Technical Director, Botanical Solutions Ltd (2014-date), Emeritus Reader in Bioorganic Chemistry at the University of Hull (2017-date), Academic Consultant at the University of Hull (2022-date), *ca* 150 original publications and review articles, 6 current World Intellectual Property Organization (WO) patents. Fellow of the Royal Society of Chemistry/RSC Chartered Chemist. Current main interesting are in sporopollenin exine microcapsules (SpECs): extraction and applications in cosmetics, nutrition, drug/vaccine delivery and bio-conjugates.