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ENVISIONING NEW CONCEPTS FOR 3D PRINTING ANDSOLUBILITY ENHANCEMENT: TABLET MANUFACTURING OF LOADED PARTECK SLC ® THROUGH Z-FORM BINDER JETTING TECHNOLOGY

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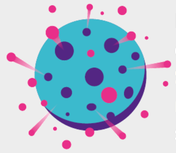
PURPOSE



Majority of drug substances in development are poorly soluble: **Solubility enhancement through mesoporous silica**: Encapsulation and stabilization in the nanosized silica pores

Traditional drug product development is often time-consuming and costly → 3D printing **binder jetting** (BJ) provides the benefits of **rapid manufacturing and scalable production** (1)

The BJ technology **Z-Form Flex** deposits powder into preformed blister cavities and forms the dosage forms layer-by-layer **directly in their primary packaging**

OBJECTIVE(S)

- **Combine** the use the **mesoporous silica Parteck® SLC** loaded with a poorly soluble drug (carbamazepine, CBZ) with binder jetting technology **Z-Form Flex** to accelerate development and improve drug delivery

CONCLUSION(S)

- Parteck® SLC loaded with CBZ can be **successfully used** in BJ technology Z-Form Flex
- **Suitable tablet properties**: Amorphous API, uniform drug content, rapid dissolution profile
- Combining both technologies could **expedite the development** of poorly soluble drugs

RESULT(S)

Tablet properties and SEM-EDS

- Tablets showed a **consistent appearance** upon removal from the blisters (Fig. 1a)
- Average mass of 806.2 mg (RSD 5.6%) **CBZ was evenly distributed** in the tablet being visualized through SEM-EDS (Figure 1b)

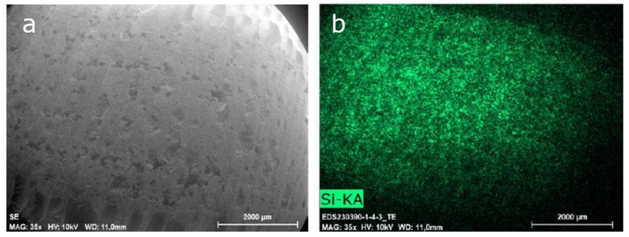


Figure 1: SEM image of tablet cross-section (a), EDS image of tablet cross-section showing distribution of silica (b)

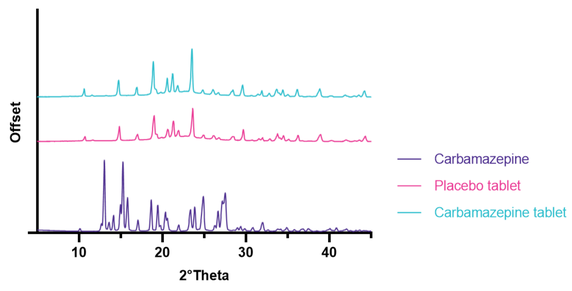


Figure 2: XRPD patterns of CBZ, placebo tablet and CBZ tablet

Solid state characterization

- **CBZ was amorphous** as no diffraction peaks related to CBZ were visible (Fig. 2).
- The peaks observed in the diffractogram were associated with the excipients in the tablet, as demonstrated by the comparison with a placebo tablet

Content and dissolution

- Tablets showed a **uniform drug content** of 5.0% (RSD 1.6%)
- The 3D printed tablets exhibited a **rapid release** with over 85% of CBZ being dissolved within 5 min

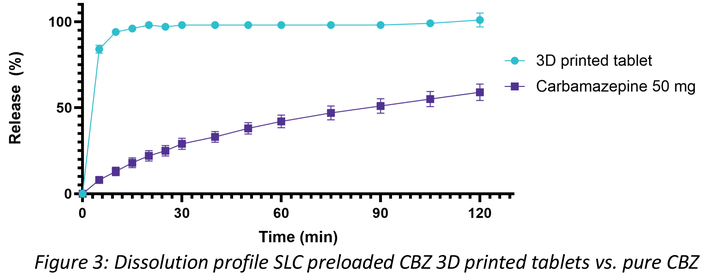
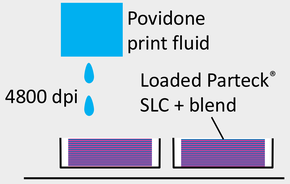


Figure 3: Dissolution profile SLC preloaded CBZ 3D printed tablets vs. pure CBZ

METHOD(S)

Silica loading

In-blister printing (Z-Form)



Ingredients	Composition (%w/w)
Parteck® SLC (pure and loaded)	26.00
Mannitol	57.24
Microcrystalline Cellulose	4.89
Corn Starch	2.09
Colloidal Silicon Dioxide	0.70
Povidone	9.08
Total	100.0

Analytics

XRPD: Miniflex (Rigaku, Japan), D/teX Ultra 2 detector, copper anode at 40 kV and 15 mA, step size 0.02° and 0.8°/min, range 3 – 50°

SEM-EDS: Tescan VEGA3 XMU (TESCAN, Germany), wolfram cathode, acceleration voltage 0.2 kV to 30 kV; EDS: Quantax (Bruker, USA)

Content: Tablets were dissolved in 250 mL of methanol. HPLC (Agilent 1260 Infinity, USA), Ascentis Express ES-Cyano column (10 cm x 4.6 mm I.D., 2.7 µm), 30 °C, flow 1.4 mL

Dissolution: AT7 (Sotax Switzerland) with paddles in 500 mL of water, 75 rpm. Absorption measured at 288 nm

FUNDING/GRANT/ENCORE/ REFERENCE OR OTHER USE

1. Tracy, T., Wu, L., Liu, X., Cheng, S., Li, X., 2023. 3D printing: Innovative solutions for patients and pharmaceutical industry. Int. J. Pharm. 631, 122480.
2. Ting, J.M., Porter, W.W., Mecca, J.M., Bates, F.S., Reineke, T.M., 2018. Advances in polymer design for enhancing oral drug solubility and delivery. Bioconjug. Chem. 29, 939–952

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