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Development of galatite-eggshell membranes and bioactive glass scaffolds for their use in bone tissue engineering.

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INTRODUCTION & AIM

Treatment of large bone defects is one of the most challenging tasks in orthopedics, an estimated of 2.2 million bone grafting procedures are performed worldwide per year. Bioactive glasses (BG) are being utilized as biocompatible, biodegradable materials and collagen (Col) represents more than 90 % of the bone organic matrix, both materials have shown excellent properties in bone repair. The galatite (Gal) is frequently named artificial bone and is a thermostable polymer obtained with casein-formaldehyde.

The current study involves the fabrication of novel 3D scaffolds conformed by galatite obtained from goat milk-casein, bioactive glass synthesized by sol-gel technique, and as a source of collagen they were used eggshell inner membranes (ESM). Four proportions were designed and identified as C1 (Gal 100 %), C2 (Gal 80 % - BG 20 %), C3 (Gal 80 % - ESM 20 %) and C4 (Gal 70 % - BG 15 % - ESM 15%).

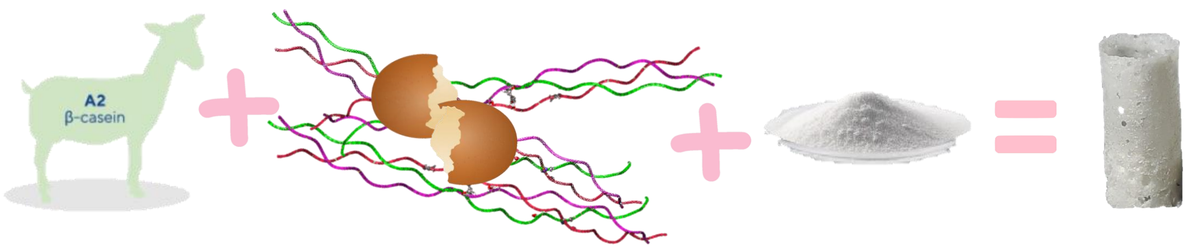


Figure 1. Galatite from goat casein

METHOD

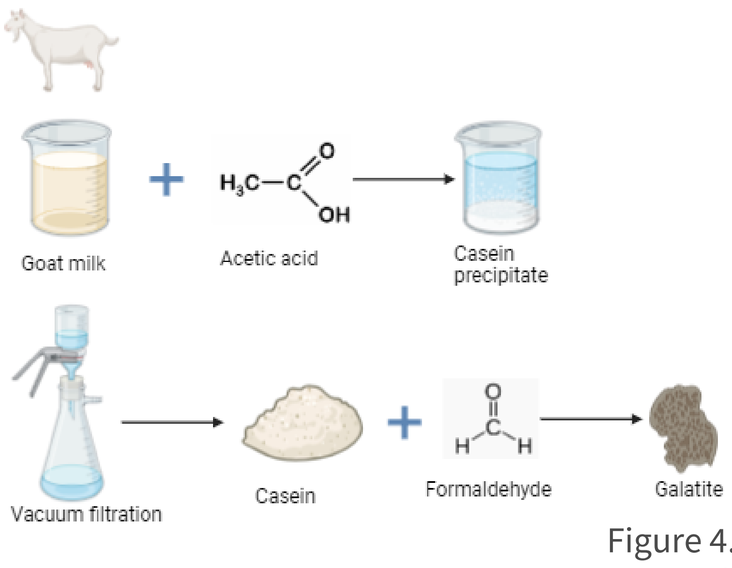


Figure 2. Gentle separation of ESM

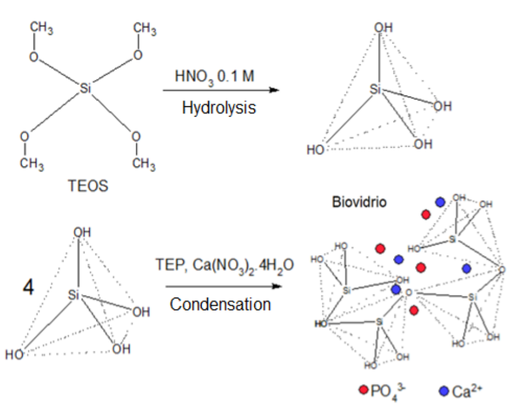


Figure 3. Bioactive glass synthesis

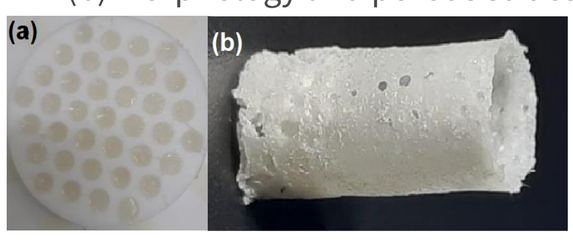
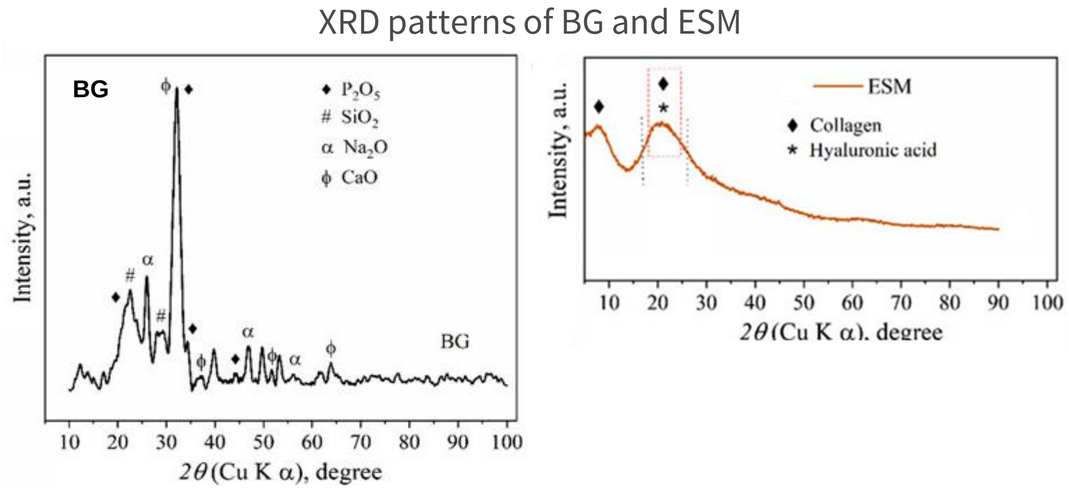


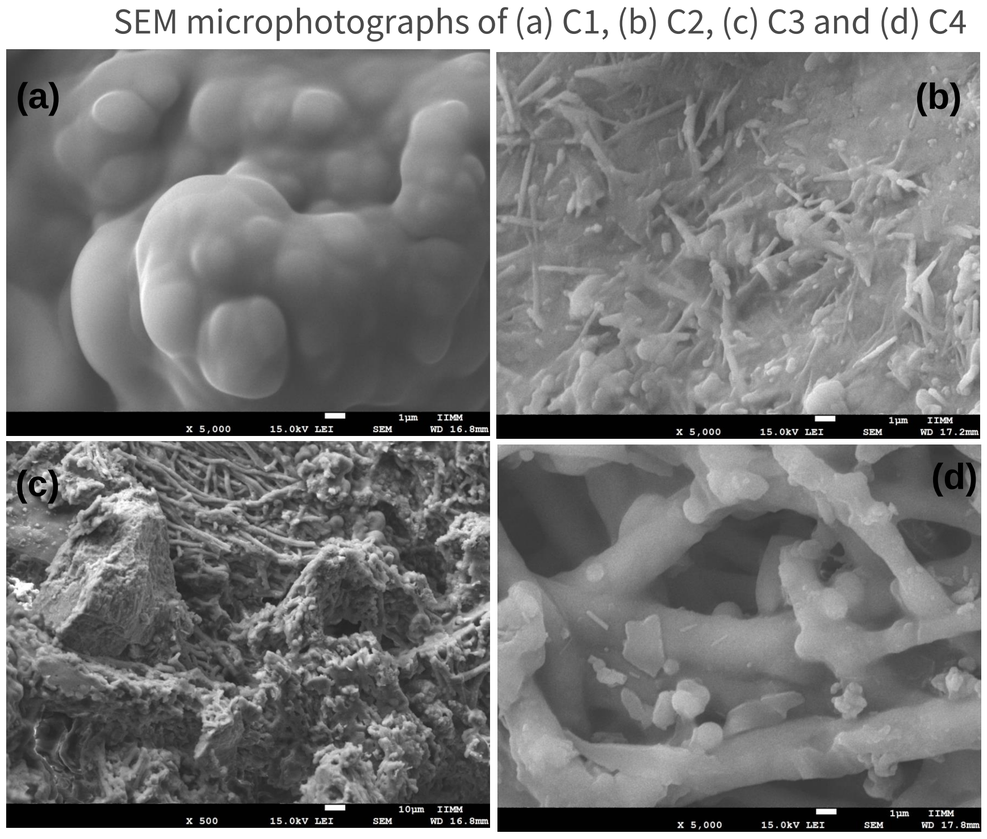
Figure 4. 3D Scaffolds design (a) Gel pressing technique (b) Morphology and porous structure

RESULTS & DISCUSSION

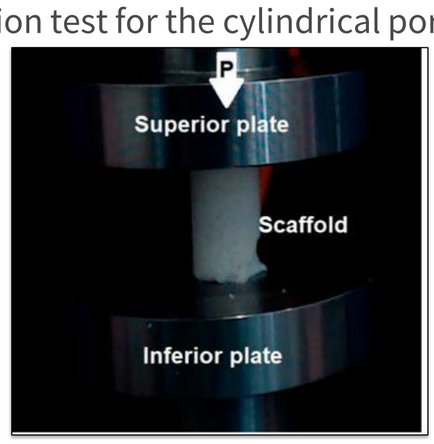
XRD patterns of BG and ESM



SEM microphotographs of (a) C1, (b) C2, (c) C3 and (d) C4



Compression test for the cylindrical porous scaffolds



CONCLUSION

Microstructural characterization results showed that Gal-ESM-BG (C4) scaffolds interconnected voids of about 8 µm in diameter. The evaluation of mechanical properties by dynamic compression showed that C4 displayed a higher compression strength related to the higher levels of collagen/hyaluronic acid present in this sample. Although, the obtained elastic module values were lower than those reported on bone assessment, they were attributed to an absence of a hydroxyapatite phase in the scaffolds.

FUTURE WORK

Further evaluations are being carried out in order to evaluate mechanical properties as torsion and elongation resistance, also, the biocompatibility and biodegradability in-vitro by the use of solutions as simulated body fluid and phosphate buffered solution at different times and the cellular viability is a must to investigate. Several electrochemical evaluations are being performed in order to observe their behavior as coatings in SS 316L.

REFERENCES

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