PHYSIO-MECHANICAL CHARACTERIZATION OF Ti—SiO_2 AND HAp-SiO_2 COMPOSITE WITH TAILORED MICROSTRUCTURE FABRICATED USING RICE HUSK AS SPACE HOLDER FOR TISSUE ENGINEERING APPLICATION

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Conclusion

The present chapter outlines the conclusions extracted from the research work. From all the above-discussed research conducted it can be understood that the main aim of the research was to valorize agricultural waste and waste animal bone by potentially utilising them as a source of biomaterials. From all the above research work the major conclusion drawn are as follows:

The major conclusions drawn from the development of porous Ti/SiO2 scaffold using RH as space holder material are as follows:

1. Porous Ti/SiO_2 composite scaffolds with tailored microstructure and property were successfully developed through powder metallurgy technique using rice husk and sucrose as fugitive material.
2. Porous composite having 15–34% porosity was obtained by varying the amount and size of RH powder in the composition.
3. Developed porous Ti/SiO_2 composite scaffolds possess Young's modulus in the range 6–15 GPa and compressive strength in the range 117–396 MPa.
4. The use of RH as a space holder material creates a scope for fabricating low-cost Ti scaffold along with an advantage of incorporation of silica in the matrix which enhances mechanical and biological properties.

The major conclusions drawn from the development of low-cost silica dopped tricalcium phosphate scaffold using RH as space holder material are as follows:

1. High-temperature sintering and addition of silica (by-product burnt RH) results in the transformation of pure HAp to TCP, and as the sintering temperature and wt% of RH increases the crystallinity of the TCP phase increases

2. Due to high temperature sintering decomposition and dehydroxylation takes place along with this an interfacial reaction between HAp and SiO_2 also takes place, which leads to phase transformation of HAp to TCP.
3. The HAp combines with SiO_2 (burnt-out residue of RH) to form silica doped TCP composite at an elevated sintering temperature and enhances the compressive strength of the porous scaffold.
4. The porosity of the scaffold was in the range of 34–61% and the compressive strength was up to 4.1 MPa.
5. A bioactive glassy network of Ca–Si–P–O amorphous phase is observed across the matrix which is also responsible for the enhancement of bioactivity of the scaffold

The physical, mechanical and biological properties of the porous scaffold are similar to that of natural bone. Thus, from the above study it can be concluded that agricultural waste and waste animal bone can be potentially utilized for the development of scaffold suitable for tissue engineering applications.

Future scope of the work

On the basis of the results obtained from the present study, the future scope of the work as follows:

1. More compositions of these ceramic and metallic-based samples can be prepared using advanced manufacturing techniques like 3D printing.
2. An advanced sintering technique like Spark plasma sintering and microwave sintering can be employed to prepare defect-free samples.

3. Further in Vivo testing of the samples can be performed on animals and systematic analysis of these data can be made.
4. If the in-Vivo results show positive behavior, then the prepared Porus scaffold can be recommended for clinical trial according to proper medical guidelines.