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Effect of a new biomaterials in the system tricalcium phosphate-dicalcium silicate on osteogenic markers expression in human mesenquimal stem cells

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INTRODUCTION

It is well known that Si-doped Ca-P bioceramics have improved biological performance compared to pure Ca-P ceramics. The significant advantages of materials containing Si are that they can induce apatite mineralization in body fluid environment and enhance osteogenic differentiation of a series of stem cells. Compositions belonging to the system dicalcium silicate (Ca_2SiO_4 = C_2S) - tricalcium phosphate ($Ca_3(PO_4)_2$ = TCP) are promising candidates for preparing new ceramic bone implants. In this context, the objectives of this work were to fabricate novel biphasic ceramics in the system C_2S - TCP, and determining the in vitro behaviour of the new ceramics in adult mesenchymal stem cell of human origin (*ah*MSCs) attachment, proliferation and differentiation.

METHODS

Compositions derived from C_2S-TCP phase diagram

EC1	EC2	EC3
31%wt TCP	59.5%wt TCP	83%wt TCP
68%wt C_2S	40.5%wt C_2S	17%wt C_2S

Novel materials with compositions derived from the Dicalcium Silicate-Tricalcium phosphate (C2S-TCP) phase diagram were developed: EC1, EC2 & EC3. Phase composition effect on their ability to support adult human mesenquiymal stem cells (ahMSCs) growth and osteogenic differentiation induction in presence of DMEM or an osteogenic medium (OM) was therefore investigated. The ahMSCs were examined at 1, 2, 3 and 4 weeks in culture for the osteoblast phenotypic markers alkaline phosphatase, osteocalcin, osteopontin and cell surface marker CD105.

RT-PCR Analysis

- Alkaline phosphatase (ALP)
- Osteocalcin (OCN)
- Osteopontin (OPN)
- Cell surface marker CD105

1 week → 2 weeks → 3 weeks → 4 weeks

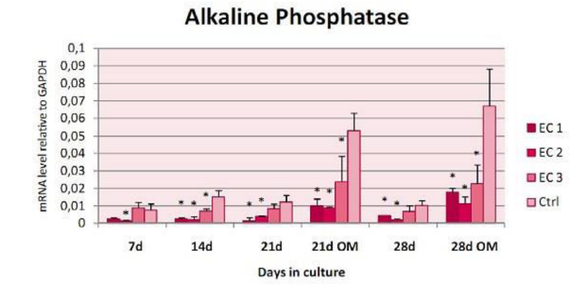
RESULTS

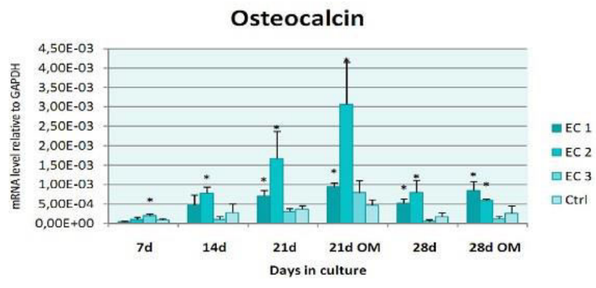
ALP
- At week 2 the population of ALP+ cells was similar for al samples.
- At week 4, the proportion of cells ALP+ increased significantly in EC2 samples.

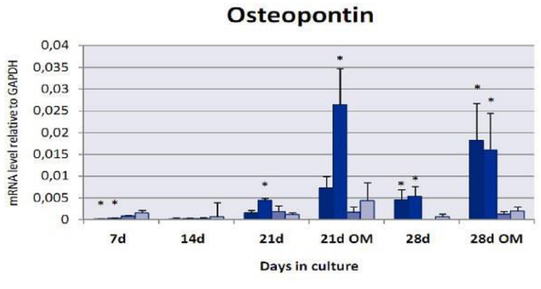
OCN
- The OCN gene expression is specially inducted by EC2.
- Treatment with OM increased the OCN gene expression.

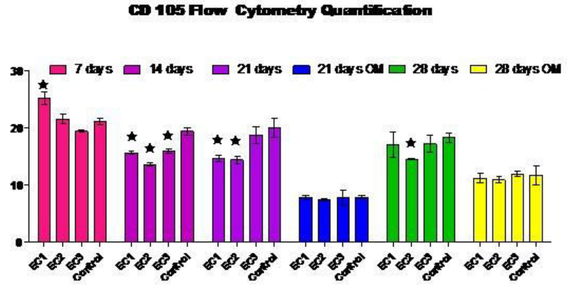
OPN
- At week 1 and 2, the OCN gene expression was similar for all samples. At week 3, the proportion of OPN gene expression increased in EC2 samples.
- Treatment with OM increased the OPN gene expression, specially in EC2 samples.

CD 105
- At week 1, ahMSCs expressed the CD105 marker in all the samples.
- Treatment with OM decrease CD105 expression significantly for EC1 and EC2 samples.









CONCLUSIONS

These experimental TCPs ceramics show appropiate biological properties providing a microenvironment optimal for the *ah*MSCs proliferation and osteoblastic differentiation. This in vitro cell test supports the hypothesis that the eutectoid ceramic obtained, specially EC2, displays in vitro bioactivity and biocompatibility, which makes its potential candidates for surgical applications.

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