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Development and Characterization of Niobium-Releasing Silicate Bioactive Glasses for Tissue Engineering Applications

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ABSTRACT

Novel niobium-containing bioactive glass formulations (Nb-BGs) were designed, produced and used to fabricate sintered glass-ceramic granules to examine their in vitro bioactivity and angiogenic potential. Nb-BGs were prepared by melting and quenching. Afterwards, the glasses were crushed and milled into fine powders. These powders were used to make aqueous slurries which were poured into molds, dried and sintered to produce pellets, from which granules of 0.5-0.85 mm in size were obtained. In vitro bioactivity was tested by immersing the granules in simulated body fluid for up to 14 days. Cell biology tests were carried out by indirect culture of bone marrow stromal cells (ST-2) with supernatants resulting from incubation of BG granules in cell culture medium. The effect of dissolution products from Nb-BGs on the secretion of vascular endothelial growth factor (VEGF) was assessed to characterize the angiogenic potential of the new Nb-containing BG compositions.

Keywords: Bioactive glasses; scaffolds; tissue engineering; Niobium; angiogenesis

1 INTRODUCTION

In terms of tissue replacement, materials that can be used off the shelf and can circumvent additional surgical procedures, possible immune reactions and donor tissue shortages are in high demand. Bone tissue engineering and replacement have been tackled using a number of approaches, usually involving the use of bioactive (osteoconductive, osteoinductive) materials [1]. Some of these