

ABSTRACT

The pearl and nacre of marine oyster *Pinctada fucata* (Gould) is an important material in view of evolving biomimetic and biomedical applications. This investigation was undertaken with the major objectives to characterize nacre and organic matrix as biomaterial (for structural assembly and substratum for animal cell growth), its role in crystal modulation and potential biological activities. SEM, AFM, HR-XRD and FTIR analyses revealed lamellar type organization of hexagonal aragonite plates [10-50 μm (*l*) x 0.5 μm (*h*)], associated with inter-and intracrystalline organic matrix in brick and mortar configuration. A single aragonite plate is an aggregate of numerous coherent nano crystals (50 ± 15 nm). The insoluble porous scaffold of β -chitin-protein complex was obtained after acid mediated decalcification of nacre that supported attachment, growth and proliferation of feline fibroblast cells. The scaffold was biodegradable with lysozyme and chitinase. Organic fractions isolated from nacre [inclusive of proteins (water, EDTA and urea soluble) and water soluble peptides (range 200- 900 Da)] modulated calcium carbonate crystal formation. All fractions together only induced aragonite type crystals. Water soluble matrix (WSM) of nacre nano powder prepared by ball milling was screened for potential biological activities. WSM (0.02 % w/ v) was found to induce osteogenesis in murine preosteoblast cells as evident from *in vitro* increase in ALP activity, nodule mineralization and upregulation of osteocalcin and collagen-I-A 2 transcripts as markers. Antioxidant activity of WSM in dose dependent manner was studied in cell free system by free radical scavenging, lipid peroxidation inhibition, ferric reducing and ferrous ion chelating abilities. Protective effect of WSM (0.05 % w/ v) was observed in H_2O_2 and UV-B induced oxidative damage in human keratinocyte cells. *In vivo* treatment of WSM (250 mg/ kg BW) in mice was found to reduce the oxidative stress as revealed from biochemical profiles of antioxidant markers present in serum and liver and showed anti-hyperglycemic activity in alloxan induced mice. The insoluble nacre protein 'pearlin' was transiently expressed in tobacco leaves, with and without ER retention signal at 1.5 % and 0.9 % level of total soluble protein, respectively.