Gene Expression Study of BALB/c 3T3 Cells in the Presence of Degradable Iron Alloy

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Introduction:

Iron based materials are preferable for cardiovascular stent application due to their appropriate ductility compared to their counterparts—magnesium alloys. However, the degradation rate of pure iron as a cardiovascular stent application is considered to be slow. Alloying was recently explored which introduced manganese (35% w/w) as the alloying element for iron through powder metallurgical process, here after called Fe-35Mn. By this mean, the measured degradation rate was faster compared to that of casted iron. Following the potential of iron manganese alloy as a degradable metallic material for cardiovascular stent application, it is important to study the effect of released elements to the cellular response through its basic mechanism—gene expression.

Materials and Methods:

Microarray gene expression study was chosen as an approach in order to generate general information towards the mechanism of cellular responses. Briefly, BALB/c 3T3 cells were exposed with 3,25 mg/ml of Fe-35Mn powder; 0,25 mg/ml of pure Mn powder; 5 mg/ml of pure iron powder (<75 um in diameter) using tissue culture inserts. At least six replicates were applied for each treatment and a group which not exposed to any metal was used as a control. Following 24-hour incubation period, mRNAs were extracted and gene expression study was conducted using Illumina platform subsequently. Data analysis was conducted by observing the gene expressions in the presence of metal in general and in the specific presence of Fe-35Mn alloy.

Results and Discussion:

Most of the significantly up-regulated genes in the presence of metal were related to transport activity for amino acids, carbohydrate and sugar, as well as metal ion transporter, oxydoreductase activities, metabolism of sterol, cholesterol, and reactive oxygen species. The up-regulated genes in the presence of Fe-35Mn were significantly related to apoptosis and the metabolism of nitrogen compounds, alcohol, organic acids, phosphorus, etc. Moreover, down-regulated genes in the specific presence of Fe-35Mn alloy, were significantly related to electron transport, monooxygenase activity, and metalloendopeptisade inhibitor activity. This gene expression study provides the mechanism of how the Fe-35Mn alloy could give influences to cellular activity and its potential for degradable metallic material application.