UNIVERSITI TEKNOLOGI MARA

MODELLING OF AVERAGE PORE DIAMETER AND POROSITY OF POROUS PCL/HA COMPOSITE BY USING ANOVA ANALYSIS

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ABSTRACT

Porous polycaprolactone/hydroxyapatite (PCL/HA) composite is said to be the most stable biodegradable scaffold for bone tissue regeneration. Hence, has initiated the researchers to study the reliability of that statement. The objective of this study is to develop mathematical relationship between the average pore diameter and porosity of porous PCL/HA composite and investigate the correlation between temperature and pressure of foaming process with the presence of HA content. The composite was prepared through solid state foaming process of supercritical carbon dioxide ($ScCO_2$). In this study, temperatures and pressures of foaming process were varies from 40℃ to 45℃ and 10MPa, 20MPa and 30MPa, respectively. In addition, HA content also were varied at 10, 20, 30 and 40 wt%, respectively. The analysis of variance (ANOVA) was done by using Microsoft Excel. The develop model shows that average pore diameter is increased with temperature but will reduced as the interaction between pressure and HA content increased. Meanwhile, develop model for porosity shows that temperature is a sole effect in increasing the porosity value. The develop model also indicated that the designated model for porosity have a high value of coefficient of determination (R^2) with 0.97 which means that it is highly fitted, while the develop model for average pore diameter is consistent with the theory which is towards the temperature and interactions between pressure and HA content. However, the fitness of the model is only 0.74 due to one data that is deviated far from the others. Therefore, validation with different values is recommended for future research.

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INTRODUCTION

1.1 Research Background and Motivation

Tissue engineering (TE) is define as an interdisciplinary field that use the principles of engineering and life sciences towards the development of tissues` organ, which can regenerate, maintain, or improve the current tissue organ. For tissue engineering that applied to bone generation by tissue-engineered implant is called as bone tissue engineering (BTE) (Chen, Z., 2017). The main purpose of developing BTE is to protect the internal organ and to increase the regeneration rate of bone tissue as well as act as temporary tissue to replace the damage tissue. Tissue implantation is usually applied to an area with a large damage tissue due to an accident that is almost impossible to recover.

In recent study, the researchers have further expanded the scope or the study of BTE by developing a new tissue regeneration aid called biodegradable scaffolds. Scaffolds are 3D engineering materials that can stimulate desirable attachment and proliferation to contribute to the formation of new functional tissues. It is used to replace the old methods for osteoporosis problem such as autograft, allograft and bone graft substitutes. The factors that need to be considered in designing the bone scaffolds are (Ghassemi et al., 2018):

1) The compatibility of cell attachment and proliferation.
2) The materials used are not toxic will not cause inflammatory reactions.
3) Biodegradability of scaffolds material to make sure that it is safe to be used.
4) Mechanical properties to bear weight during amelioration period.
5) Proper structure for porosity (80 - 95%) and pore diameter (215-402.5μm) for cell penetration, nutrients, waste transfer, and angiogenesis.
6) Sterilibility without losing of bioactivity.
7) Ability to transfer drug or molecules inside the tissue.