CHAPTER 1

INTRODUCTION

Polyhydroxyalkanoates (PHAs) are homo- or heteropolyesters that are synthesized by a wide variety of bacteria. They are biodegradable and biocompatible under appropriate conditions. This has generated a high interest in them as substitutes to petroleum-based polymers in many applications (Braunegg, 2002). To date, PHA have been investigated and evaluated for various medical applications such as controlled release, surgical sutures, wound dressings, surgical meshes, bone grafts and many more (Ueda and Tabata, 2003).

Most of the clinical issues in the oral and maxillofacial region are attributed to bone loss which may be caused by many factors including trauma, tumours, developmental deformities and degenerative diseases.

Guided bone regeneration is an effective method in halting tissue and bone destruction and in promoting new bone formation in small defects. Numerous techniques and biomaterials have been discovered that indicate good clinical signs and histological results. Yet, the ability of these materials to achieve complete and predictable regeneration still remains debatable. The most commonly used materials in guided bone regeneration include bone replacement grafts from numerous sources such as autografts, allografts, xenografts and alloplastic materials (Bashutski and Wang, 2009).

Recent studies showed that PHA has a potential to be a substitute bone graft to be used in oral and maxillofacial region (Ong *et al*., 2005; Abdul Rahim *et al*., 2008). Previous research carried out in this institute demonstrated good biocompatibility of PHA in soft tissue. The presence of bone formation in the soft tissue prompted a speculation on the possible osteoinductive properties of PHA compared to poly-L-Lactic acid, in hamsters (Ong *et al.,* 2005).

Subsequently, a study done by Abdul Rahim *et al.* (2008) which used commercial PHB, Poly [(*R*)-3-hydroxybutyric acid] as a bone graft substitute in the rabbits' mandibles, reported that this material has an osteoconductive effect. Arising from this study, we have substituted PHB granules with medium-chain-length PHA (mcl-PHA) in the form of a membrane. The material is produced in-house from palm-oil utilizing bacteria, using methods described by Tan *et al.* (1997) who reported that saponified palm kernel oil could be used as a carbon substrate by bacteria to produce mcl-PHA.

So far, most studies involved PHAs of short-chain-lengths. Building on the past attempts mentioned above, the present study aims to determine if the mcl-PHA could act as a tissue engineering scaffold in the oral and maxillofacial region to regenerate bone tissues. Therefore, the aims of this research can be summarized as the following:

- To determine the tissue response in rabbit mandibles to bacterial mcl-PHA.
- To investigate the potential of the mcl-PHA as an osteoconductive biomaterial.