PREFACE

In the name of God, the Most Beneficent and the Most Merciful

The research and development of a copolymer from of palm oil based macromer with MMA for dental application is a cooperative effort and depends on the contributions of several individuals and organizations. Sincerest gratitude is extended to my supervisor and co-supervisor, Professor Dr. Gan Seng Neon and Associate Professor Dr. Noor Hayaty Abu Kasim for their invaluable advice, support, constructive criticism and constant encouragement, striking a perfect balance between providing direction and encouraging independence.

I extend my appreciation to the members of Polymer Research group of Chemistry Department, UM including Professor Dr. Rosiyah Yahya and Associate Professor Dr. Aziz Hassan and the staffs namely Ms. Nisrin, Ms. Ho Wei Ling and Mr. Zulkifli for their guidance, technical advice and helpful discussions throughout this investigation. The appreciation also goes to the staffs from Biomaterial Unit Laboratory, Faculty of Dentistry, UM, including Mr. Ismail Jaafar, Pn. Zarina, Pn. Azizah Zainal Abidin and those who have help me directly or indirectly during my time working there. My gratitude also goes to those from Department of Mechanical Engineering whom included Mr. Zaini (workshop) and Mr. Nazarul Zaman (SEM laboratory).

In addition, it has also been a pleasure to work with fellow graduate students including Ms. Azlina Puang, Ms. Lee Siang Yin, Mr. Fadhel Ali Alsanabani, Ms. Tang Bee Kim, Ms. Sonja Then, Ms. Wong Jun Xuan, Ms. Chan Siang Yee, Ms. Ng Wei Goon, Ms. Neo Su Siang, Mr. Wong Yew Chuan, Mr. Gan Yik Kang, Ms. Siti Fatimah and all the polymer group members.
Funding for this work has been provided by grant from Ministry of Science, Technology and Innovation (MOSTI), E-science fund 03-0103-SF0190, University of Malaya, Postgraduate Research Vote PS 079C/ 2007C and National Science Fellowship (NSF August 2007 – August 2009). For this assistance, I am very grateful.

The deepest appreciation also goes to my parents, Mr. Shahabudin Mahmud and Pn. Asah Mat, who have been a source of continuous encouragement and prayers. The list also goes to my siblings, Syazwani, Shahril, Naim, Syamimi and Nabil whom without them I could probably not finish the dissertation.

Last but not least, I also would like to convey warmest appreciation to all my best friends, including Ami, Yuna, Syada, Fana, Najem, Ann, Dayah, Sarah and Kay for their invaluable support and encouragement in this long endeavor of completing this dissertation.
This dissertation describes the study using a specific palm kernel oil macromer, namely FA35 to modify the poly(methylmethacrylate) (PMMA) in attempt to enhance its properties of as a denture base polymer. This study is divided into two sections: (I) Characterization and copolymerization of FA35 macromer and methyl methacrylate (MMA), and (II) Evaluation of the copolymers as a denture base material. Copolymerization of macromer and MMA was carried out by solution and bulk processes. Both methods used benzoyl peroxide as initiator. This macromer-MMA copolymerization process was stable at 80°C for solution technique. Lower temperature was sufficient for bulk method which was from 60-70°C during the process of producing the pre-polymer syrup and 60°C for overnight curing. At the end of the reaction, the mixture was heated to 100°C for one hour to evaporate off residual monomer. Fourier Transform Infra Red (FTIR) analysis and thermal characterization of the copolymers confirmed that they contained repeating units from both macromer and MMA. Addition of cross-linking agent, ethylene(glycol dimethacrylate) or EGDMA did not significantly affect the T_g of the copolymers. Differential Scanning Calorimetry (DSC) analysis showed single value of T_g was obtained for each copolymer. Copolymers containing up to 20% w/w of macromer unit showed significantly lower water sorption. In addition, solubility of crosslinked copolymer (Group B) was relatively low and comparable with the solubility of the commercial resin. Mechanical test revealed that incorporation 5-10% w/w of macromer has significantly improved the impact and flexural strength of the PMMA, but further increase of macromer beyond 15% w/w progressively lowered the mechanical strength of copolymers. Visual inspection was performed to
determine type of fracture in the copolymers, from the two fragments resulting from the flexural test. Both broken fragments could be repositioned at the fractured line, presenting a smooth surface; hence the fractures were classified as brittle. Overall, the experimental copolymers which contained a noteworthy amount of non-petroleum based materials derived from palm oil increased the mechanical strength of acrylic resin.
ABSTRAK

menunjukkan penggabungan makromer dengan rantai tak tepu ini telah meningkatkan kekuatan impak dan kelenturan (flexural) PMMA. Walaubagaimanapun, penambahan makromer melebihi 15% w/w merendahkan kadar kekuatan impak dan kelenturan kopolimer ini. Analisis mikroskopi dijalankan bagi menganalisis jenis retakan (fracture) daripada fragmen pecahan yang diperoleh dari ujian “flexural”. Kedua-dua fragmen tersebut didapati boleh disusun semula pada garis retakan dan menghasilkan permukaan yang licin; oleh yang demikian, retakan dikira sebagai “brittle fracture”. Keseluruhannya, kopolimer yang terhasil, yang mengandungi sejumlah bahan bukan-petroleum daripada kelapa sawit dapat mempertingkat kekuatan mekanikal resin akrilik.