



UNIVERSITI PUTRA MALAYSIA

***CO-COMPOSTING OF OIL PALM FROND WITH PALM OIL MILL
EFFLUENT***

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**CO-COMPOSTING OF OIL PALM FROND WITH PALM OIL MILL
EFFLUENT**

By

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June 2012

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The oil palm biomass namely empty fruit bunches (EFB), oil palm fronds (OPF) and oil palm stems (OPS) are by-products, which are produced about 40 million tons per year, and it has been of great concern recently due to the significant impact on the environment. In the normal practice, the conventional method of OPS and OPF disposal for replanting the oil palm through burning technique at the plantation can cause the problems of air pollution. Composting has been considered as one of the alternative methods to convert organic wastes into beneficial products that benefit plant growth and soil amendment. Therefore, this study was conducted to investigate the physicochemical changes and microbial community during co-composting of oil palm frond and POME anaerobic sludge. The study was carried out at Faculty of Biotechnology and Molecular Science, UPM at a pilot scale with capacity of 1 tonne of oil palm fronds. The ratio of POME anaerobic sludge added onto OPF throughout the composting treatment was one

to one. Two batches of composting process were carried out using different structure of oil palm frond (OPF) as compost substrate, namely chipped and chipped-ground oil palm fronds. Results showed that co-composting of OPF and POME anaerobic sludge completed within 60 days with average Carbon/Nitrogen (C/N) ratio of 20. The final or matured compost was grayish in color, having a texture and earthy smell close to that of natural soil. Furthermore, composting of chipped-ground OPF gave better performance with high thermophilic temperature at 56°C and maintained for 35 days, while composting of chipped OPF resulted in 52°C, lasting for only 7 days. The oxygen level and moisture content of the chipped-ground compost was maintained at 2.0-12.0% and 60-70%, respectively, while the chipped compost were 18-20% and 55-60%, respectively. The pH for both composting processes was maintained at 7-8 (alkaline condition). The total bacteria count observed in composting of chipped-ground OPF and chipped OPF were 13×10^{10} cfu/g and 55×10^{10} cfu/g at 0 day and decreased to 0.5×10^{10} cfu/g and 3.7×10^{10} cfu/g at 60 DOC, respectively. The carbon to nitrogen ratio observed in composting of chipped ground OPF and chipped OPF was 64 and 80 at 0 day and decreased until 18 and 20 at 60 days of composting, respectively. The final cured compost for both composting processes contained a considerable amount of nutrients and trace elements. The heavy metal contents such as Cr, Cd, Pb and Ni in the final compost were low and within US EPA level, $< 20 \text{ mg kg}^{-1}$. The diversity of the bacterial community investigated using polymerase chain reaction-denaturing gradient gel electrophoresis (PCR-DGGE) indicated that the composting processes of chipped and chipped-ground OPF with POME anaerobic sludge was dominated by *Pseudomonas sp.* species.

Abstrak tesis yang dikemukakan kepada senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains

**PROSES KOMPOS MENGGUNAKAN PELEPAH SAWIT DAN SISA
KILANG SAWIT**

Oleh

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Biojisim sawit seperti tandan kosong sawit, pelepah sawit dan batang sawit merupakan hasil sampingan yang terhasil sebanyak 40 juta setahun dan menjadi kebimbangan disebabkan impak yang signifikan terhadap isu alam sekitar. Menurut praktis kebiasaan, kaedah konvensional melupuskan batang dan pelepah sawit untuk tujuan tanam semula dengan teknik pembakaran di ladang sawit akan menyebabkan masalah pencemaran udara. Proses kompos telah dipertimbangkan sebagai salah satu kaedah alternatif untuk menukar sisa organik kepada produk berfaedah yang berguna untuk pertumbuhan tanaman dan pembaikpulihan tanah. Sehubungan dengan itu, kajian ini telah dijalankan untuk mengkaji perubahan fisiko-kimia dan komuniti mikrob semasa proses kompos pelepah sawit dan enapcemar anaerobik sisa kilang sawit (POME). Kajian telah dijalankan di Fakulti Bioteknologi dan Sains Biomolekul, UPM pada skala rintis dengan kapasiti 1 tan pelepah sawit. Nisbah jumlah isipadu enapcemar anaerobik sisa kilang sawit kepada jumlah OPF yang digunakan dalam proses kompos ialah satu kepada satu.

Dua kumpulan proses kompos telah dijalankan menggunakan pelepah sawit dengan struktur dan tekstur yang berbeza, iaitu pelepah kepingan kecil dan pelepah kepingan terkisar. Hasil ujikaji mendapati bahawa proses kompos pelepah sawit dan enapcemar anaerobik sisa kilang sawit (POME) telah dijalankan sepenuhnya selama 60 hari dengan purata nisbah karbon : nitrogen pada paras 20. Produk akhir kompos berwarna kelabu dan mempunyai bau seakan tanah. Proses kompos pelepah keping terkisar adalah lebih baik pada suhu fasa termofilik 56°C dan bertahan selama 35 hari berbandingkan proses kompos pelepah kepingan kecil yang mencatatkan suhu termofilik pada 52°C dan bertahan selama 7 hari sahaja. Paras oksigen dan kandungan lembapan yang dicatat untuk proses kompos pelepah keping terkisar ialah masing-masing 2.0-12.0% dan 60-70%, manakala kompos menggunakan pelepah kepingan kecil pula mencatatkan masing-masing 18-20% dan 55-60%. Bacaan pH yang direkod untuk kedua-dua proses kompos ialah kekal pada tahap alkali, iaitu 7-8. Jumlah kiraan bakteria yang dicerap untuk proses kompos pelepah keping terkisar dan pelepah kepingan kecil ialah masing-masing, 55×10^{10} cfu/g dan 13×10^{10} cfu/g pada hari permulaan dan menurun kepada 3.7×10^{10} cfu/g dan 0.5×10^{10} cfu/g pada 60 hari proses kompos. Nisbah karbon : nitrogen yang dicatat untuk proses kompos pelepah keping terkisar dan pelepah kepingan kecil ialah masing-masing, 64 dan 80 pada 0 hari dan menurun kepada 18 dan 20 pada 60 hari proses kompos. Produk akhir kompos mengandungi jumlah nutrien dan elemen surihan yang berpatutan. Kandungan logam berat seperti kromium, kadmium, plumbum dan nikel di dalam produk akhir kompos adalah rendah dan di bawah piawaian US EPA, iaitu <20 mg/kg. Kepelbagaian komuniti mikrob yang diselidik menggunakan kaedah 'polymerase chain reaction-denaturing gradient gel electrophoresis' (PCR-DGGE) menunjukkan

bahawa spesies dominan sepanjang proses kompos untuk dua kumpulan kompos berbeza ialah *Pseudomonas* sp.



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I certify that a Thesis Examination Committee has met on 8 June 2012 to conduct the final examination of Mohd Najib bin Ahmad on his thesis entitled “Co-composting of Oil Palm Frond with Palm Oil Mill Effluent” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] March 15 1998. The Committee recommends that the student be awarded the Master of Science.

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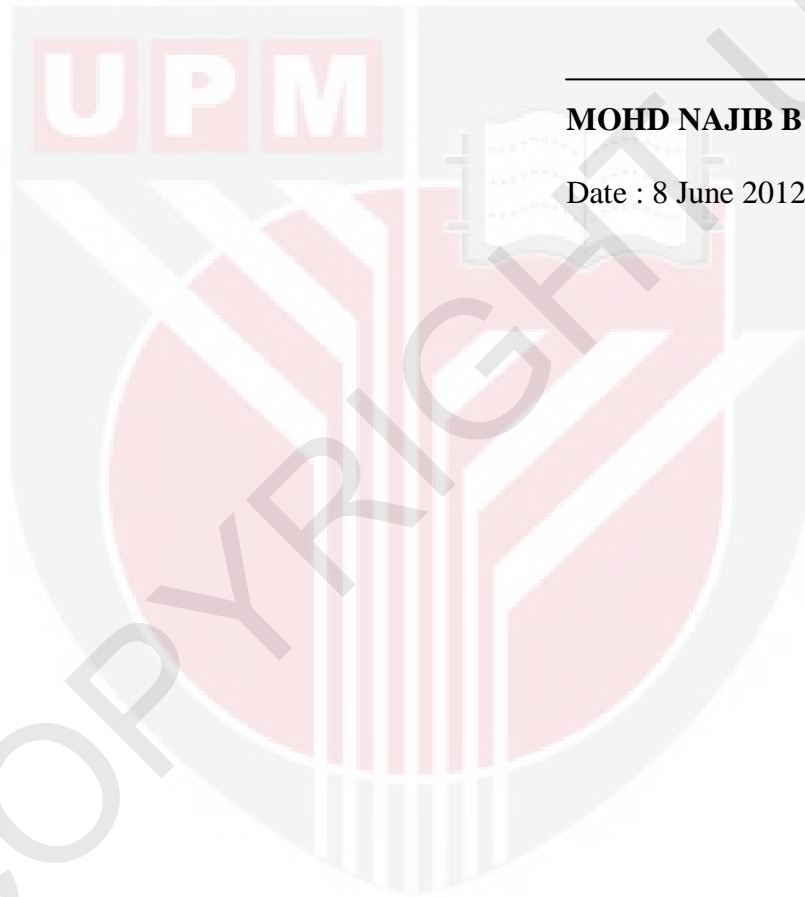
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DECLARATION

I declare that the thesis is my original work except for quotations and citations, which have been duly acknowledge. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or other institutions.



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