CHAPTER 6

CONCLUSION

In this research focuses on screening cellulose-, amylase-, protein- and lipid-degrading microorganisms for speed up the composting of organic solid waste. The conclusion are as follows;

1. Five hundred and fifty four selected cultures, covering many genera and species of bacteria, fungi and actinomycetes, were screened for cellulase, starch, protein and lipid degradation. Among the 100, 73, 67 and 87 isolates were found to be cellulose-, amylase-, protease- and lipase-positive. From these cultures, there were 20, 12, 10 and 11 isolates which gave clearing zone bigger than 15 mm. on carboxy methyl cellulose agar, starch agar, skim milk agar and tributyrin agar at 50°C, respectively. The results of the selection of effective organisms by quantitatively enzymatic assays showed that LHE 10, LHE 3, LHE 12 and LPA 15 gave the highest cellulase activities with 0.1277, 0.0775, 0.1152 and 0.0784 U mL^{-1} respectively, GB 12 had the highest amylase activity with 0.2559×10^{-3} U mL^{-1}, BS 1 had the highest protease activity with 0.2508 U mL^{-1} and PC 2 had the highest lipase activity with 97.765 U mL^{-1}. Regarding to morphology, biochemical and also DNA sequencing test it was found that all the bacteria isolates, LHE 3, BS 1, GB 12 and LPC 2, were identified as *Bacillus subtilis*. An actinomycete isolate of LPA15 was

Streptomyces regensis. One mold isolate, LHE 12, could be identified as *Aspergillus flavus*. but the other one, LHE10, was an unknown species.

2. Four strains of cellulose degrading microorganisms were *Bacillus subtilis* LHE 3, *Aspergillus flavus* LHE 12, *Streptomyces lilaceus* LPA 15and unknown fungi LHE 10, one strain of protein degrading bacteria was *Bacillus subtilis* BS 1, one strain of starch degrading bacteria was *Bacillus subtilis* GB 12 and one strain of lipid degrading bacteria was *Bacillus subtilis* LPC 2, all of these were used as mixed culture inoculum in composting. Three compost inocula i.e. Formula 1 (10^5 CFU g^{-1}), Formula 2 (10^6 CFU g^{-1}) and Formula 3 (10^7 CFU g^{-1}) belonging to different concentration of microorganisms and Market brand inoculum(10^6 CFU g^{-1}) were analysed for their ability of decomposting sterile rice straw (as model of agriculture wastes). The Formula 2 inoculum was chosen as compost inoculum.

3. From the composting process in laboratory, the growth of total thermophilic bacteria, fungi, actinomycetes and cellulose-degrading microorganisms of composting with addition of inocula (Market brand and CMU) significantly increased in number more than decomposting without inoculum all over the time of composting process. However, the growths of total thermophilic fungi and actinomycetes growth in composting with Market brand inoculum were rather lower than that in composting with CMU inoculum. On the contravention, the growth of thermophilic bacteria and cellulose-degrading microorganisms were similar for both decomposting with Market brand and CMU inocula. The C/N ratio of decomposting with CMU inoculum significantly accomplished maturity of decomposition of rice straw prior to that decomposting with Market brand inoculum. Likewise pH change from alkaline to

neutral level in decomposing treatment with CMU inoculum took precedence over the others.

4. As for the composting process in field experiment, there were very similar trends of physical, chemical, and microbiological factors during composting between Market brand and CMU inocula and these were significantly different from control piles (without compost inoculum) all over the composting time. The growth rates of thermophiles and mesophiles of bacteria, fungi, actinomycetes and cellulose-degrading microorganisms in compost piles with Market brand and CMU inocula were significantly ($p<0.05$) faster than those of control piles. the addition of effective organisms from inocula was active and prompted to accelerate processing of decomposing organic matter in composting piles. The initially rapid rise in temperature of compost piles with Market brand and CMU inocula were relatively short-lived and after 60 days of composting, temperatures of compost piles with CMU inoculum had fallen to ambient temperature (30°C) significantly faster than compost piles with Market brand inoculum.

The pH of the all piles gradually decreased.

In our experiment the moisture content dropped gradually during composting time. The compost piles with CMU inoculum after 60 days of composting period have early achieved an acceptable level of quality of mature compost with less than 50% moisture content.

With regard to the C/N ration in this experiment, the maturity of compost expressed at low level of about 13 - 20 then, proper time for composting maturity had to calibrated by other parameters, especially at equilibrium temperature of inside and outside composting pile.

Among the composting treatment, the cellulase activity was found to be higher in compost piles with CMU inoculum.

At the end (80 day) of composting process, all measuring parameters were total organic carbon, total nitrogen, total phosphorus, total potassium, total calcium, total magnesium, electrical conductivity (EC) values and germination index of compost treatments with Market brand, CMU inoculum and control approached to the regulation of complete compost and were in standard of Land Development Department, Thailand. Certainly, they could be acceptable and used as fertilizer.