CHAPTER 6
CONCLUSIONS

In conclusion, all of the results in this study can be summarized as follows:

1. From 11 strains of microorganism, *Aspergillus* sp. KPFC 277 was the most efficient microorganism, producing crude β-glucanase which were:
   - Active at pH 3.0 and 7.0 and temperature 40 °C as in the gastrointestinal tract of an animal
   - Stable at temperatures up to 75 °C for at least 15-30 sec in feed pelleting process.
   - No toxin contamination.
   - Suitable for local animal feed materials
2. Culture medium and cultivation conditions for β-glucanase production by *Aspergillus* sp. KPFC 277

   Optimized culture medium: Rice bran (solvent extract)

   Optimized culture conditions

Initial pH	5.9
Temperature	30 °C
Medium : distilled water	1: 1.5
Inoculum	10^4 spores/g
Time	96 h

   Compared with the shake flask cultures, the production of β-glucanase in solid-state fermentation with improved culture medium and cultivation conditions were approximately 241 and 105-fold higher at pH 3.0 and 7.0, respectively.
3. Tapioca flour was the most favorable carrier for enzyme preservation. It had to be mixed with the cultured diet at a ratio of 1: 1 (w/w) and then dried at 40 °C for 6 h.
4. The crude enzyme of *Aspergillus* sp. KPFC 277 was safe for animal because it did not destroy the target cells (baby hamster kidney (BHK) and human hepatocyte cell line (HepG2), did not have aflatoxin and ochratoxin.

5. The β-glucanase powder could be kept at room temperature, however the activity was maximized when the β-glucanase powder was kept in a sealed bag and stored at 4 °C to maintain the activity whether the package was opened or unopened.
6. The *in vitro* digestibility demonstrated that crude β-glucanase supplementation improved digestibility of β-glucan.
7. Average daily feed intake and average daily gain of the piglets were not significantly different among the treatments (P> 0.05). However, at the same level of β-glucanase activity added, the piglets fed with diets containing KPFC 277 or imported enzyme tended to have a better production performance in terms of ADG and showed significant difference in terms of feed conversion ratio (P< 0.05) than the piglets fed with the without-enzyme diets. Therefore, the piglets fed with KPFC 277 or imported diet tended to have the lower feed cost per gain (31.82 and 31.81 Baht/kg, respectively) than without-enzyme diet (34.48 Baht/kg). The results showed that the supplement of crude β-glucanase preparation of *Aspergillus* sp. KPFC 277 was of the same quality as imported enzyme.

Recommendation for future work

Although a tendency for the use of β-glucanase as an alternative feed supplement for monogastric animals was clearly visualized, based on the results obtained from this research in which some physiological functions and an economic evaluation were intensively considered, further research work still needs to be studied.

1. Biochemical characterization and purification of β-glucanase
2. For β-glucanase production process, more study is recommended using other by-products such as brewers' dried grain in solid-state fermentation.
3. Study suitable level of enzyme supplementation and the interaction between β-glucan and enzyme level.
4. Testing of enzyme quality by *in vivo* digestibility.