CHAPTER VI
CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

In this research, the natural dyes extract which were essential component in DSSC were investigated. The natural dyes were extracted from yellow cotton, spirulina, indigo and red orchid using deionized water. For optical properties, each dye extract showed different absorption wavelength due to the difference of chemical substance. The maximum absorption wavelength of red orchid, spirulina, indigo and yellow cotton extract was 519, 620, 626 and 488 nm which were pelargonidin, *c*-phycocyanin, indigo and lutein, respectively. Furthermore, the maximum absorption wavelength of them was shifted to higher wavelength or called "bathochromic shift" when they absorbed on ZnO. This was due to the π-π interaction between dye and ZnO. Therefore, the mechanism which dye used to adsorb on ZnO was studied. Batch adsorption which was kinetic and isothermal adsorption was used to study the adsorbed mechanism of dye on ZnO. For kinetic adsorption, the pseudo-first-order and pseudo-second-order were determined. The experiment showed that the dyes preferred to use pseudo-second-order to adsorb on ZnO. Therefore, the dyes used chemical adsorption mechanism to adsorb on ZnO. Moreover, the isothermal adsorption data showed that the dyes used both Langmuir and Freundlich model to describe how they adsorbed on ZnO but the Langmuir model was fitted a little bit higher than the Freundlich model.

In order to enhance the conversion efficiency of DSSC, the mixed dyes and QDs were used. The optical properties of QDs were determined. It was found that the QDs in ethanol appeared the maximum absorption wavelength at 269, 276 and 290 nm for Ag_2S, CdS and ZnS, respectively. Furthermore, the emission wavelength was 385, 385 and 420 nm for CdS, ZnS and Ag_2S, respectively. In part of mixed dyes, the yellow cotton extract was chosen to mix with others because it had the absorption wavelength near the emission wavelength of all QDs. The conversion efficiency of them showed that the mixed yellow cotton-spirulina had the highest conversion efficiency equaled to 0.0145%. This data indicated that mixed dyes system improved

the conversion efficiency of DSSC when compared with pure yellow cotton extract. After that this system was used to fabricate with ZnO/QDs. The experimental data showed that the conversion efficiency increased with increment of dipping time of producing QDs on ZnO and ZnO/CdS at 9 min had the highest efficiency at 0.0345%

6.2 Recommendations

Based on what have been discovered in this study, the following recommendations are suggested.

1. The mixed dyes couple which give the high conversion efficiency is investigate.
2. Size effect of QDs to the conversion efficiency is determined.