CHAPTER 6

CONCLUSION AND RECOMMENDATION

According to the cultivation of *S. platensis* in laboratory of the present study, it was determined that the highest algal biomass production was obtained at day 10 of the cultures in 5% Sw (0.90 g L^{-1} and N : P = 6 : 1) which was higher than the cultures in 10-100%Kw media and 10-100%Sw media. Similarly, the results obtained from *S. platensis* cultivation in the outdoor concrete experimental tanks indicated that the highest algal biomass production was also obtained at day 10 of the cultures in 5%Sw (0.90 g L^{-1} and N : P = 6.3 : 1) which was significantly higher than the cultures in 10%Sw, modified Zm, 100%Kw and 90%Kw, respectively ($p<0.05$).

In more detailed results, the cultivation of *S. platensis* in the outdoor concrete experimental tanks revealed the highest production of β-carotene and C-phycocyanin in the cultures with 10%Sw (0.42 mg g^{-1} and 23.32 mg g^{-1}), while the highest γ-linoleic acid production was found in the cultures with modified Zm (0.302 mg g^{-1}).

The production cost of *S. platensis* cultivation in the cultures with modified Zm was 310.60 bath kg^{-1} (dried weigh). For the productions of other nutritional parameters of *S. platensis* cultivation, it was found that the highest protein produced in the cultures with modified Zm (54.44%) with moisture content of 10.95%. However, the highest carbohydrate or nitrogen free extract (NFE) production was found in *S. platensis* cultured in 5%Sw (51.38%), while the highest fat, fiber and ash were produced in the cultures with 100%Kw (3.13, 10.65 and 27.94%).

At the end of the experiments for nutrients reduction in the waste water used as culturing media (100%Kw, 90%Kw, 10%Sw and 5%Sw media), the values of monitored parameters including BOD, COD, NH_3-N, ON, TKN, NO_3-N, TON and TN were significantly decreased compared to those values in controlled modified Zm ($p<0.05$).

In the comparison between the cultivations of *S. platensis* cultured in cement raceway ponds and earthen raceway ponds, the biomass production (range of 0.80-0.85 g L^{-1}), production cost (range of 221.58-240.00 baht kg^{-1}), and protein production (range of 39.40-40.82%) were not statistically different.

Although, nursing of larval Tuptim tilapia in the earthen pond, using raw *S. platensis* form different diet-treatments including 5% commercial diets (5%CD) as control, 1% raw *S. platensis* (1%RS), 3% raw *S. platensis* (3%RS) and 5% raw *S. platensis* (5%RS), the present study resulted as 5%CD had enhanced the highest average weight, weight gain percentage and specific growth rate in the larval fish during the first 60 days of the experiment (day0-60), however, during day-60 and the completion at day-90, the resulted performances of all the feeding formulas were not statistically different. This indicated that the raw *S. platensis* was a promising partial in feeding formula for nursing larval Tuptim tilapia. In addition, the result was also clear that the highest immunity of nursed larval Tuptim tilapia, measured as unit of lysozyme activity, red blood cell and white blood cell counts, was determined in the larval fish fed with 5%RS.

For the analyses of physico-chemical parameters as quality of water used for nursing larval Tuptim tilapia in earthen ponds, it indicated the air temperature of 30.00-31.00 ^{o} C, water temperature of 27.03-31.33 ^{o} C, water pH of 7.17-9.07,

alkalinity of 70.87-112.75 mg g^{-1}, TDS of 113.33-140.00 mg g^{-1}, conductivity of 213.33-265.33 μS cm^{-1}, DO of 5.70-8.13 mg g^{-1}, PO_4-P of 0.003-0.005 mg g^{-1}, NH_3-N of 0.010-0.017 mg g^{-1}, which revealed the water quality of the nursing ponds was within the standard values (Tave, 1990)

The result of culturing male juvenile Tuptim tilapia with four different diet-treatments, including commercial diets with 0% raw *S. platensis* (0%RS), 45% raw *S. platensis*+55% rice polish (45%RS), 50% raw *S. platensis*+50% rice polish (50%RS) and 55% raw *S. platensis*+45% rice polish (55%RS), indicated no different, where the experimented male juvenile Tuptim tilapia fed with 55%RS and 50%RS had shown the highest protein efficiency ratio. The result of culturing female juvenile Tuptim tilapia with the same four different diet-treatments, including 0%RS, 45%RS, 50%RS and 55%RS indicated the highest average weight, weight gain percentage and specific growth rate with 0%RS and 55%RS, while the highest protein efficiency ratio in female juvenile Tuptim were found in the fish fed with 55%RS and 50%RS. Additionally, the highest immunity of cultured male and female juvenile Tuptim tilapia, measured as unit of lysozyme activity, red blood cell and white blood cell counts, was determined in the fish fed with 55%RS.

Although the content of β-carotene was found to be high in the flesh of juvenile female Tuptim tilapia fed with 50%RS and 55%RS, due to the nature of the diet treatment with already high β-carotene content, but the β-carotene contents found in the experimented fish eggs were not significantly different among different diet treatments.

Because of the already high content of C-phycocyanin in 55%RS, C-phycocyanin contents found in the flesh and eggs of juvenile Tuptim tilapia fed with

such diet treatment were also high. Similarly, the high content of γ- linoleic acid in 50%RS and 55%RS had resulted as the high γ - linoleic acid content found in eggs of juvenile Tuptim tilapia fed with the treatments. However, the γ- linoleic acid content from the flesh was not significantly different.

The diet treatments of 50%RS and 55%RS in culturing female juvenile Tuptim tilapia had the result of high protein in the flesh and eggs of the fish. These two diet treatments had also high carbohydrate in the eggs significantly, but not in the flesh of the fish. These had also lowered the fat in flesh and eggs of the fish which enhanced the better nutritional value. In addition, the production variable costs of juvenile Tuptim tilapia from all the experiments were not significantly different. The study culturing male and female juvenile Tuptim tilapia had also found that the diet treatments of 45%RS, 50%RS and 55%RS indicated high gonadosomatic index (GSI%).

For the analyses of physico-chemical water quality used for culturing Tuptim tilapia in earthen ponds, it indicated the water temperature of 20.83–28.67 ^{o}C, water pH of 6.93–7.30, alkalinity of 95.00–107.00 mg g^{-1}, TDS of 93.00–173 mg g^{-1}, conductivity of 183.00–360.00 μS cm^{-1}, DO of 5.67–11.40 mg g^{-1}, PO_4-P of 0.10–0.30 mg g^{-1}, NH_3-N of 0.04–0.27 mg g^{-1}, which indicated that all the parameters had increased according to the increasing content of *S. platensis* in the diet treatments. However, the water quality in both the juvenile fish and mature fish ponds was within the standard values (Tave, 1990)

It can be concluded that the highest biomass productions of *S. platensis* cultures, both in laboratory and cement tanks, could be obtained from the cultures in 5%Sw (0.90 g L^{-1} and N : P~ 6 : 1). In the cultivation of *S. platensis* in the

experimental tanks, β-carotene and C-phycocyanin content were highest in 10%Sw, while γ- linoleic acid was highest in the cultures with modified Zm. The highest production cost by dried weight, highest protein production and moisture content were also found in the cultures with modified Zm. The highest carbohydrate or NFE production was found in *S. platensis* cultured in 5%Sw, while the highest fat, fiber and ash were produced in the cultures with 100%Kw. In addition, the results also indicated that, at the end of the experiments, water quality in the cultures with 100%Kw, 90%Kw, 10%Sw and 5%Sw media were better than the water quality in the culture with modified Zm.

In the cultivations of *S. platensis* in cement raceway pond and earthen raceway pond, where the biomass production, production cost and protein values were not statistically different. The present study has confirmed that the 10%Sw and 100%Kw can be used as the culturing medium for the cultivation of *S. platensis* where the results of biomass, β-carotene, C-phycocyanin, γ- linoleic acid and protein produced were similar to the control experiment using modified Zm, while the production cost was comparatively lower.

Furthermore, being used as the culturing medium for algael cultivation, the wastewater could be pre-treated to gain better water quality before being discharged into natural water source. On the other hand, the algal biomass gained from the cultivation can be used as the additional food source in livestock farming, such as, being used for the nursing and culturing Tuptim tilapia fish which can help to save the production cost following the “sustainable economy theory” invented and introduced nationally by His Majesty the King of Thailand. In addition, algal cultivation can also help to reduce carbondioxide (CO_2) content in the atmosphere since the process

requires high CO_2 content, helping to reduce the greenhouse gas which causes the climate change.

It was suggested that 5%CD should be firstly used as feed in nursing larval Tuptim tilapia for the first 60 days. After that 5%RS can be used to enhance the higher average weight, weight gain and specific growth, as well as, higher immunity.

Culturing male and female juvenile Tuptim tilapia with the diet treatments of 55%RS and 50%RS had also enhanced higher protein efficiency ratio and immunity. For culturing of the female juvenile Tuptim tilapia with 50%RS and 55%RS, high content of β-carotene was found in the flesh of the fish, while high content of C-phycocyanin was found in both flesh and eggs of the fish. With these same diet treatments, γ - linoleic acid content in the eggs of juvenile Tuptim tilapia was also high, which caused the higher protein in the flesh and eggs of the fish, while carbohydrate in the eggs was high, fat in the flesh and eggs were low. These enhanced the better nutritional values. The production costs of juvenile Tuptim tilapia from all experiments were not significantly different.

In addition, culturing male and female juvenile Tuptim tilapia with feed mixed with *S. platensis* can also enhance higher gonadosomatic index (GSI%). The present study has confirmed that using *S. platensis* as partial feed for mature Tuptim tilapia can enhance the increasing weight of reproductive organ and more eggs produced. This proven concept of using the *S. platensis* biomass as the supplementary feed for Tuptim tilapia and/ or other fishes, can be introduced to local fisheries. Fish feed which composed of 45%RS (or 4.5% dried weight) were prepared in to pellet by the wet extruder, to get the ready-to-use fish feed, then the better quality of fish flesh and eggs can be expected. It was suggested that the diet of

50%RS and 55%RS (or 5%RS and 5.5%RS dried weight) should be used to obtain high protein and pigment, while water quality in the nursing pond can also be maintained within the accepted standard (Tave, 1990).

Recommendation

1. The further study of *S. platensis* in kitchen wastewater for determination of toxic and non-toxic substances is needed before the biomass production is applied for animal feed.
2. The production cost of nursing and cultivation of Tuptim tilapia using *S. platensis* as additional feed source should be compared to other optional feed.
3. Oil-extracted soybean fermented water should be performed considerably far from the community because it has foul-smelling.
4. Pigment extraction from *S. platensis*, meat and eggs of Tuptim tilapia should be applied with other methods since it needs to be purified.
5. Various levels of "*S. platensis*" can be the substitute for protein from fish meal and other sources, while the effects of the β-carotene content in "*S. platensis*" on the fish should also be investigated.
6. Raw *S. platensis*: 50%RS and 55%RS (or 5%RS and 5.5%RS as dried weight) should be used as additional feed in nursing Tubtim tilapia fish to obtain better quality of fish flesh and eggs, high protein and pigment,

where water quality in the nursing pond can also be maintained, thus reducing environmental impact.

7. Local fisheries should be introduced with the proven concept of using 45%RS biomass (or 4.5% as dried weight) as additional feed source for Tubtim tilapia nursing with the application of the wet extruder to get the ready-to-use fish feed, in order to induce the fish to produce the reproductive organ with more weight and then promise for more eggs produced. In addition, the water quality in the fish ponds can also be maintained within the standard range.