CHAPTER 1

INTRODUCTION

Since fish is an important source of nutrition for human, understanding its high nutritional value is therefore appropriate. A freshwater fish, Tuptim tilapia (*Oreochromis* sp.), was chosen for this study for its good marketability. Tuptim tilapia is a hybrid fish between female red tilapia ND5 family line and male red tilapia ND6 family line (Figure 1). Both ND5 and ND6 tilapia came from the separate crosses between Nile tilapia (*Oreochromis niloticus* Linn.) and Java tilapia (*Oreochromis mossambicus* Peters) (Aquaculture Production Technology Ltd., 2004).

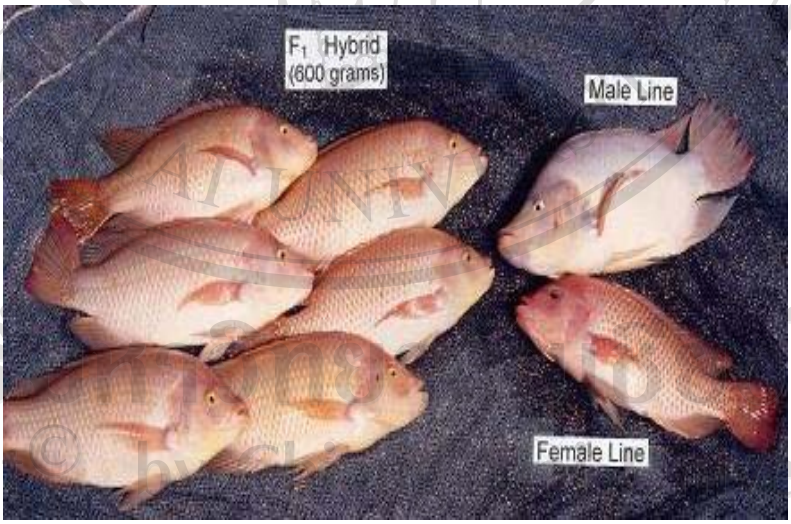

Figure 1 Hybrid (F_1) fish between female red tilapia ND5 family line and male red tilapia ND6 family http://www.aquaculture.co.il/Technology/ND56.html

The stages of development of Tuptim tilapia for marketing are shown in Figure 2. The advantages of this attractive species for aquaculture in Thailand are its tasty flesh, high protein, low fat and high quality of nutrients and its fast growth as well as the ease of culturing and processing. However the cost of nursing and culturing Tuptim tilapia in Thailand increases continually, and the survival rate of this fish is normally low. Using a low cost and readily available natural feed to replace the commercial feed for Tuptim tilapia would lower the production cost. It has been reported that some juvenile and adult fish, including Tuptim tilapia, Nile tilapia and Java tilapia, are phytoplankton filters in the aquaculture system (Hakan *et al*., 2003), so it would be worthwhile to utilize microalgae as a readily available and easily grown food source.

Among the microalgae, *Spirulina platensis* (Nordstedt) Geiteler, (Figure 3 and 4) one of the phytoplankton in the division Cyanophyta, a mixotrophic unicellular microalgae, can be easily and cheaply recovered by filtration from the culture medium because of its relatively large size. *S. platensis* has even been used as nourishment by the Mexican and African for a long time (Bold and Wynne, 1985).

This microalgae has been the subject for nutritional research for three decades and has been produced on various scales and degrees of sophistication. It has gained world wide acclaim as a good source of protein, β-carotene, C-phycocyanin, vitamins and minerals for healthy human food and animal feed (Switzer, 1982; Venkataraman, 1983).

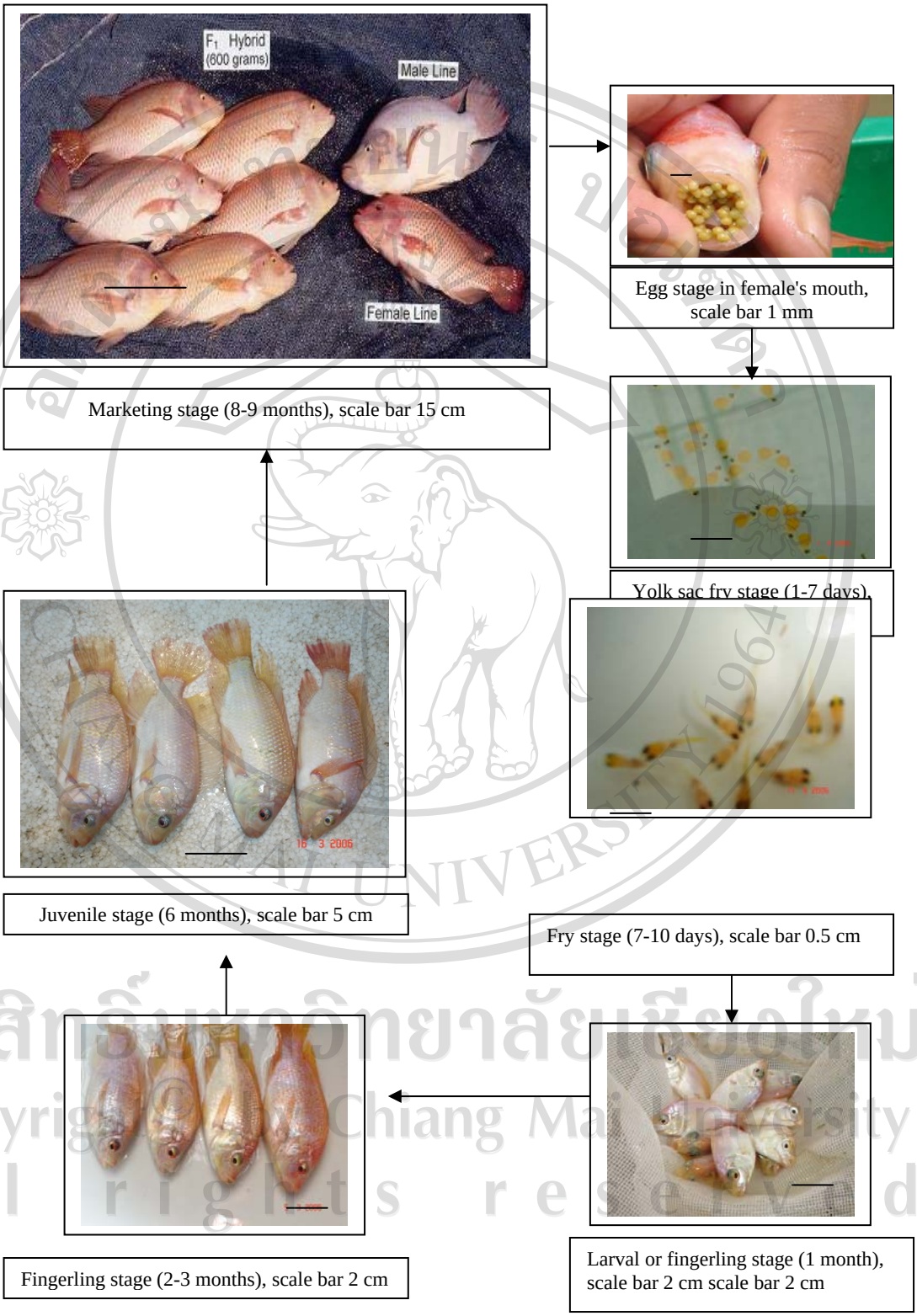

Figure 2 The stages of development of Tuptim tilapia for marketing

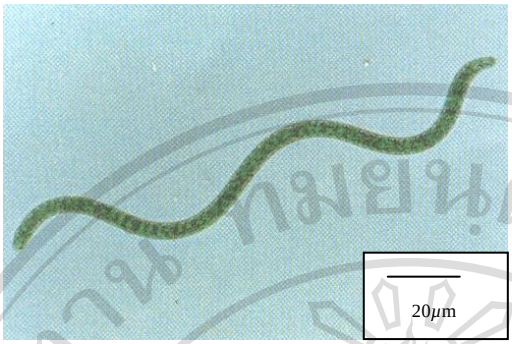

Figure 3 *S. platensis* unicellular

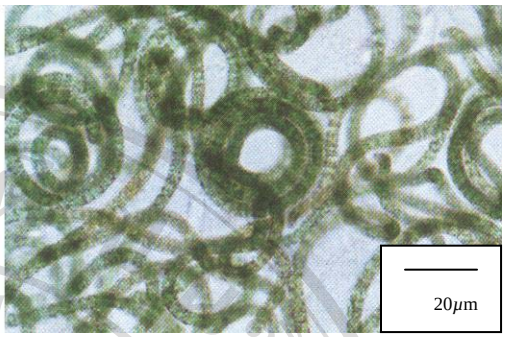

Figure 4. *S. platensis* mass

S. platensis presents advantages due to the high protein content (60-70%) and the amino acid content is similar to that recommended for human or animal consumption by the FAO (Richmond, 1998). C–phycocyanin is one of the major biliproteins of *S. platensis*, a blue green algae, with antioxidant and radical scavenging properties. It is also known to exhibit anti-inflammatory and anti-cancer properties in humans and animals (Schlfsser, 1982).

It was concluded that *S. platensis* was more acceptable than *Euglena* and *Chlorella* as a diet for larval and adult tilapia from the onset of exogenous feeding (Jun *et al*., 2004). The study of spawning and egg quality of Nile tilapia fed on raw *S. platensis* throughout three generations revealed significant differences in the fatty acid profile of the eggs, the survival rate of the larval fish was high and the eggs contained more γ-linolenic acid (GLA). It was also concluded that tilapia fed on raw *S. platensis* could maintain normal reproduction throughout three generations (Lu and Takeuchi, 2003). Tilapia are able to utilize β -carotene from *S. platensis* to fulfill the dietary vitamin-A requirements. Tilapia raised on *S. platensis* have higher survival rates compared to those raised on commercial fish feed diets. They grow quickly with

improved nutritional properties and tastes, therefore have high market acceptance (Chien *et al*., 2006).

Algae need nitrogen and phosphorous as major nutrients for their growth. Various researches have used inorganic culture medium mixed with animal wastes, kitchen and factory wastewaters and urban effluents to grow *S. platensis* to reduce the cost of algal biomass production (Promya *et al*., 2006; Rangel-Yagui *et al*., 2004; Siew-Moi *et al*., 2000; Bustos *et al*., 1992). These wastes and wastewaters are rich in nutrients (nitrogen, phosphorous, fats, proteins, carbohydrates, etc.). *S. platensis* is quite efficient in removing nitrogen and phosphorous from culture media since their growth rate is highly dependent on the N and P content (Carr *et al*., 1998). There are 2 general methods to culture *S. platensis* commercially, raceway pond and cement circular pond. Peddle wind and aeration pumps are needed in these ponds to circulate microalgae mass up for light. The cost of operations and algal productions of these two ponds are still uncertain and needed to be evaluated.

The present study aims to comparatively investigate the effects of raw *S. platensis* and commercial diets, as feed sources, on the survival of larval and juvenile of Tubtim tilapia. *S. platensis* used as feed will be mass cultured in the effluents obtained from kitchen and oil-extracted soybean fermented water. The analyses of these water qualities as well as some nutritional evaluation together with C-phycocyanin, β-carotene and γ-linolenic acid (GLA) contents in *S. platensis* and in flesh and eggs of Tuptim tilapia fed on raw *S. platensis* were also included. The assessment of fish immunity as unit of lysozyme activity minute, leucocyte counting

and gonadosomatic index in tilapia fed on raw *S. platensis* and production variable cost from culturing Tuptim tilapia will be carried out in this research.

Objectives of the study

1. To investigate the physico-chemical qualities of kitchen wastewater compared to that of oil-extracted soybean fermented water used for *S. platensis* culture.
2. To investigate the biomass and nutritional values of *S. platensis* cultured in both water sources in cement raceway pond and earthen raceway ponds.
3. To investigate the effects of 4 levels of raw *S. platensis* as Tuptim tilapia feed compared with that of the standard feed of commercial diet on growth rate and some nutritional values in the flesh and eggs of the fish at juvenile stage and fecundity in Tuptim tilapia fed on raw *S. platensis*.
4. To investigate the effect of *S. platensis* feed on the immunity stimulating capacity in fish.
5. To investigate production variable cost of *S. platensis* and Tuptim tilapia culturing.