Introduction

The *Mytus nemurus* (Cuvier and Valenciennes) or green catfish or yellow catfish (Suvatti, 1950) is one of the most important freshwater fish cultured in Thailand and other countries in Southeast Asia, belongs to Order Siluriformes, Suborder Siluroidei, and Family Bagridae. Mass production of the catfish juveniles was achieved by artificial breeding (Amatyakul *et al.*, 1995), and hatchery for fries distribution throughout the country (Leesa-Nga, *et al.*, 2000). The green catfish is one of the most popular and economically important foods in Thailand that has gained popularity among consumers. Analysis of dried green catfish indicated that the fish was high in omega-3 fatty acids, and the level was higher than that found in marine fish such as sardine (Mesomya *et al.*, 2002). Because of the fish's palatability and high nutritive values, the business farming is preferred and the consumer demand is relatively high (personal communications). As the return of the investment in catfish farming is engaged in the production outcome, several efforts thus have been accomplished in order to seek for the optimal growth and survival of the juveniles. These include reproductive traits (Khan *et al.*, 1990; Hardjamulia and Suhenda, 2000), digestive process and capacity (Kamarudin *et al.*, 2001), feeding behavior (Amornsakun *et al.*, 1997, 1998), types of diet (Khan *et al.*, 1993; Eguia *et al.*, 2000), and the effect of stocking density (Khan, 1994). However, the outcome of the fishery is still inconsistent. The mortality rate is still high, in particular during the first week after hatch (Amatyakul *et al.*, 1995; personal communication with the Songkhla Inland Fisheries Station).

Thyroid hormones have a wide range of biological effect on numerous vertebrate species including mammalians (for reviews see Bernal and Nunez, 1995, Bettendorf, 2002), avians (for review see McNabb, 1989), amphibians (for reviews see Tata, 1999, Shi *et al.*, 2001), and fish (for review see Power *et al.*, 2001). The major role involves growth and developmental regulations of young animals, as well as regulation of the basal metabolism of macromolecules, such as carbohydrate and lipid (Brent, 1994), in adults. Thyroid hormones predominantly elicit their action via binding to a specific nuclear receptor named thyroid hormone receptor (TR) which is a member of the nuclear receptor superfamily.

According to its role on numerous aspects of vertebrate development and metabolism, investigations to reveal the functions of thyroid hormone have been emphasized in particular the higher vertebrate species. In the lower vertebrates, particularly in fishes, studies have been attempted to reveal the biological role of the thyroid hormones in these species. These include the observations on changes of the thyroid hormone level during developmental stages (Tanaka *et al.*, 1995), effects of thyroid hormones administration on growth and development of fish, and the influence of the hormones on metabolism. The role of thyroid hormones have been demonstrated in some teleosts including carp (Lam and Shama, 1985), tilapia (Lam, 1980; Nacario, 1983), and zebrafish (Brown, 1997). Carbohydrates and lipids are the macromolecules in fish that their metabolisms has been reported being regulated by thyroid hormones (Tripathi and Verma, 2003). In addition, several efforts have been attempted on thyroid hormone receptor (TR) in order to elucidate the mechanism of thyroid hormone actions. Thyroid hormone receptors from several fish species, including Japanese flounder (Yamano *et al.*, 1994), zebrafish (*Danio rerio*)(Essner *et al.*, 1997), Atlantic salmon (*Salmo salar*)(Marchan *et al.*, 2001; Jone *et al.*, 2002), have been cloned and sequenced. Moreover, subtypes of TR and distribution of the mRNA in various tissues during development have been reported in fish including Japanese flounder (Yamano and Miwa, 1998), rainbow trout (Jones *et al.*, 2002), zebrafish (Essner *et al.*, 1997, 1999), and seabream (Nowell *et al.*, 2001). However, in comparison with the knowledge in mammals, the effect of the thyroid hormone, in particular that on the metabolic pathways, has been little known in fish.

The function of the endocrine system during early ontogeny and metamorphosis was examined in several marine fish. The decrease of thyroid hormone level in tissues occurred during embryonic development to the stage of completion of yolk absorption. However, the hormone level was gradually increased during early larval life, and was significantly elevated during developmental changes to juveniles (Tanaka *et al.*, 1995). The thyroid hormone increased to a maximum around the metamorphic climax, followed by a mark decrease after metamorphosis of the fish. Treatment of fish larvae with thyroid hormone apparently stimulated the uptake of protein and fat in digestive tract. This suggested the benefit of using exogenous thyroid hormones in growth enhancement of fish larvae (Tanaka *et al.*, 1995).

Thus, based on the documentation of hatch ability and survival enhancement in fish species, efforts were attempted in this project to improve the hatching rate and survival of juvenile *M. nemurus* by using thyroid hormones. In addition, more attempts were contributed to understand the effect of thyroid hormone on metabolism during early development, as well as the molecular mechanism of the thyroid hormone actions, in this green catfish.

Objectives

The experimental researches were conducted to elucidate the role, effects, and actions of thyroid hormones in the green catfish which leading to use the hormones as an exogenous supplementation for the improvement of mass production of the catfish.