CHAPTER 1

Introduction

1.1 Situation of aquatic production and the using of protein hydrolysates

Global fish production has grown steadily in the last five decades with food fish supply was increased at an average rate of 3.2 percent annually, outpacing world population growth at 1.6 percent. The total fishery production in 2014 was 93.4 million tons from capturing, 81.5 million tons of which from marine waters and 11.9 million tons from inland waters. Amount production from aquaculture accounted to 73.8 million tons, with an estimated first-sale value of US$160.2 billion. Apparent fish consumption per capita increased from an average of 9.9 kg in the 1960s to 20 kg in 2014. In others to the increase in production, several factors have contributed to rising production such as reductions in wastage, distributed channels improvement, better utilization, and increasing demand linked to population growth, rising incomes and urbanization (FAO, 2016). The aquaculture sector has expanded and diversified in the last couple of decades mainly based on increased external feed inputs, and in particular on increased use of compound aqua-feeds (Tacon *et al.,* 2011). The aquaculture feed industry is responsible for converting raw materials of agricultural origin into feeds. These feeds are not only important in terms of cost but also in terms of nutrition, as some of these feeds are the primary source of animal and plant protein required by cultivated aquaculture species for normal development. In addition, this is a broad industry employing people with a variety of skills, including fish farmers, process engineers, economists, marketing experts, shellfish and fish scientists, regulatory experts, quality control technicians, and transportation and distribution specialists (Nates, 2016). Using availability local raw materials as ingredients in aquaculture feed can help to contributes to a sustainable utilization of resources as well as potential growth in aquaculture production with less impacted to environmental. Moreover, the critical evaluation of feed ingredients in feed development. It can be seen to discriminate the effects on feed

intake from the results on the utilization of nutrients from raw materials for growth and other metabolic processes (Glencross *et al.*, 2007). Most of feed ingredients used in aquaculture diets can be classified as protein sources; energy sources; essential lipid sources; vitamin supplements and special ingredients to promote growth, pigmentation, or sexual development in the species, or to enhance physical properties, palatability, or feed preservation (Hardy, 2000)

As the increasing demand for fish meal (FM) with the development of the aquaculture industry, the worldwide FM's yield cannot meet the demand of the feeding industry. Therefore, in order to develop intensive aquaculture systems, alternative of high quality protein sources are required to replace high-cost FM (Aksnes *et al.*, 2006). Many cost-effective alternative protein sources have been examined to substitutes for FM in aqua-feeds (Tacon and Metian, 2008). As some promising results, utilization of high level of plant protein sources in carnivorous fish diet face a numerous challenge due to their unsatisfied characteristics such as deficiency amino acid profile and anti-nutritional factors (ANFs) that can impact to growth performance and health status of fish (Francis *et al.*, 2001). By developing of the modern food processing technologies, has been interested in directly towards the potential use of leftovers from fisheries by catch and seafood processing which have been a long discarded as waste or processed into low market value products (Hsu, 2010).

Currently, the fish processing industry more than 60% were produced as waste, including head, trimmings, skins, frames, fins, viscera and roes, and only 40% fish yield for human consumption (Dekkers *et al.*, 2011). These huge quantities of fish leftover waste from fish processing industries would impact serious pollution and create problems in both developed and developing countries. Especially in Thailand, fisheries accounted 1.5 percent of the country's exports, producing more than 4.2 million tons of fish and seafood, which 90 percent is targeted for the export market this included tuna, shrimp and fish as the main fishery products exported. This scenario demonstrates the high capacity of the fishery industry of Thailand not only in the production but also in processing sector (Fisheries, 2013). These huge by-product wastes contained a rich amount of protein that are regularly processed into low market-value products, such as animal feed, low quality fish meal and fertilizers (Hsu, 2010). In view of utilizing these

protein rich fish processing wastes, many bio-techniques have been developed to an improved exploitation of the essential feed nutrients and bioactive compounds. Not least these techniques would help to improve for human health by protecting from several diseases and providing a good nutrients for good health status, and to revise the environment pollution and as well as disposal problems. Currently, the bio-techniques are employed to recover the nutritional and physiological important peptides by enzymatic hydrolysis of fish proteins that results in the production of biologically active protein hydrolysates from these commercially low value fish processing by-products and underutilized fish species (Raghavan *et al.*, 2008). With the advantage of these enzymatic techniques, many fish protein hydrolysates has produced from various protein rich fish by-products wastes (Ahn *et al.*, 2010).

Fish Protein Hydrolysates are the conversion products from fish processing industries waste, which includes head, trimmings, skins, frames, fins, viscera and roes, In the recent years the conversion of inexpensive fish processing by-products and underutilized fish proteins into valuable products got special attention by the food scientists all over the world. Currently, fish protein hydrolysates are considered the most important source of protein and bioactive peptides (Neklyudov *et al.,* 2000). Protein hydrolysates gained from fish proteins are essential nutritional supplements as bio-active compounds with easily absorbed and utilization for various metabolic activities (Nesse *et al.,* 2011). Fish protein hydrolysates with good nutritional combination, amino acid profile, and antioxidant activities have a great attained of food scientists. According to the presence of essential nutrients and bioactive components fish protein hydrolysates experience various industrial applications. In many countries, traditional and commercial application of fish protein hydrolysates are currently used as functional foods, health foods, and nutraceuticals (Chalamaiah *et al.,* 2012). Several studies have been examined the dietary effects of hydrolysed protein on the growth of Atlantic salmon *Salmo salar* (Lall, 1991, Berge and Storebakken, 1996); rainbow trout *Oncorhynchus mykiss* (Aksnes *et al.*, 2006), goldfish *Carassius auratus* (Szlaminska et al., 1993), tilapia *Oreochromis niloticus* (Fagbenro *et al.*, 1994), carp larvae *Cyprinus carpio* (Carvalho *et al.,* 1997), and Japanese sea bass *Lateolabrax japonicas* (Carvalho *et al.,* 1997).

Red-tail catfish (*Hemibagrus wyckioides*) belongs to the native fish fauna of many rivers in the Asian countries, especially in Thailand, Cambodia, Myanmar, Laos and also in China (Kottelat, 1998). Its meat attract a high appreciation among the fish consumers, this can enhance its marketable price is jumped higher than for some other kinds of fish such as the Nile tilapia (*Oreochromis sp*.), common carp (*Cyprinus carpio)*, walking catfish (*Clarias sp.)* and others (Tippayadara *et al.*, 2016). In central part of Thailand red-tail catfish is a widely popular cultured in cages to reach marketable sizes. The fish also does well in adaptation across a general water chemistry and temperature range, and can eats a wide various of prepared, frozen and live foods. For this reason makes it become an excellent candidate species for intensive aquaculture (Hee and Rainboth, 1999). Although some techniques in rearing red tail catfish have been developed yet the problem of low growth rate is a major hindrance in increasing its production (De Silva, 2016). Protein is the most important component in feeds, not only because of its high economic cost and high requirements in carnivorous fish diets but also because growth promoters are associated with some protein sources (Wilson, 2002).

To the best of our knowledge, there are no available studies concerning the replacement of fish meal by fish protein hydrolysate in diet of juvenile red-tail catfish (*H. wyckioides*)

1.2 Purposes of the study

To investigate the optimum replacement level of fish meal by protein hydrolysate on growth performance, survival rate and carcass quality for rearing red-tail catfish *(H. wyckioides)*