1. INTRODUCTION

Ornamental fishes are familiar pets in the universe and aquarium keeping is pertaining to people’s stress relieving hobby. The fascinate fins and attractive colors of fishes are amiable to children and family members. Ornamental fish culture has spread all over the world, particularly in developed tropical countries. India being a tropical country, ornamental fishes have attracted with enormous characters. Establishment of ornamental fish trade would speedily improve the production and human resources can be profitably developed, to promote economic status of our country. Ornamental fish culture provides more employment opportunity of unemployed people and self help groups and reduce drudgery to strengthen nation and reduce vulnerability. Though keeping of ornamental fishes as pets has long been fancied as hobby, it could be commercially exploited to earn a living. Ornamental fish culture is making a source for creating self employment through services of aquarium maintenance in public place like hotels, railway stations, parks, hospitals, airport and factory and can provide additional income. Ornamental fish farming can be a promising alternative for many people. It requires little space and less initial investment than most other forms of aquaculture. For starting of an ornamental fish farm, sophisticated equipments are not necessary. Only a clear understanding of habits and biology of the fishes, basic needs are required. So it can be practiced even in urban areas with little alternation of backyard or even the roof of a dwelling. As less man power is needed, the women or the elders can run small home units. Most of the families run small home units to earn additional monthly income. Generally, men have other professions and they only look after the seed collection and marketing. The house women can do the every day care of aquarium.
The Government of India is also giving financial assistance to the interested people who culture the ornamental fishes. Apart from financial assistance from the rural, co-operative and national banks, Marine Products Export Development Authority (MPEDA) provides support to the fishermen and unemployed youths for setting up ornamental fish breeding units.

Environmental conditions favour Indian ornamental fish culture industry, which has been growing at an average annual rate of 13%. An endowment of India’s Western Ghats and North Eastern Hills has tremendous potential of ornamental fish habitats. The mountain along the west coast of peninsular India, the Western Ghats make up one of the unparalleled biological regions of the world. The mountain ranges extend from the southern tip of the Indian peninsular to northwards, about 1600 km, upto the mouth of river Tapti. They rise to an average altitude between 900 and 1600 m above mean sea levels, intercepting monsoon winds from the south-west and creating a rain shadow zone in the region to their east. This region receives an annual rainfall ranging from 1000 to over 6000 mm. The varied favourable climate and diverse topography create a wide array of habitats, that environment supports to aquaculture and improve water sources and promote aquaculture. The diversified Indian aquatic environment harbours about 2118 species of fishes. The country has about 600 fish species that have promising market as ornamental fish. The North Eastern region homes around 300 native ornamental fish out of the 806 freshwater fishes found in India. In India, the North Eastern states are taking a main role in the ornamental fish market. The North Eastern states contribute around 85% of the total market and the rest comes from the southern states of India. Among the ornamental fishes, the freshwater fishes are so valuable and it represents 90% of
the trade as against 10% marine fishes. The marine aquarium keeping is not an easy job for the hobby person.

In India, exotic fish dominate the domestic market. Already 288 exotic varieties have been recorded in Indian market. More than 200 species of these freshwater fish, are bred in different parts of India and others still have to be imported as fry (Mahapatra et al., 1999). Presently, only about 52 native fish species from West Bengal have been earmarked as aquarium fish (Ghosh et al., 2000). The domestic ornamental fish market is worth around Rupees 500 million and demand is increasing at 20% annually. The total global export market for ornamental fish is estimated at US $ 427 million. Development of ornamental fish industry would benefit the rural youths to earn a living from the surrounding natural resources. Kolkata as a distribution and export center from here the fishes are sent to different states of India by air or road. About 90% of Indian export is reported from Kolkata followed by 8% from Mumbai and 2% from Chennai. Several varieties of freshwater ornamental fish from India have great demand in foreign countries.

The ornamental fish culture is reflected omnipresent aquaria that feature as an integral part of modern interior decoration (Katia Oliver, 2001). The classification of ornamental fishes will be considered from a very broad context based upon the reproductive characteristics of the species. Ornamental fishes can be divided into oviparous and ovo-viviparous. The oviparous are expelled their eggs from the female prior to fertilization (egg-layers) and in an ovo-viviparous, the eggs are fertilized and incubated internally followed by expulsion of larvae from the body. The live bearer includes almost 1000 species in the world. Generally live bearing fish are considered viviparous meaning that
fertilization and hatching of the eggs take place within the body of the female. Development of the embryos occurs within the female until live young ones are released from female fish.

The live bearer fishes are most popular among hobbyists because of their attractive colours and the fact that they are easy to breed and keep. Red swordtail is getting importance for aquariums and garden pool in recent years with their attractive colors and features. Red swordtail has demand in foreign market and could also be tried for breeding and propagation. In order to keep up with the constant demand for intense color varieties, commercial farmers are encouraged to collaborate with hobbyists. The red swordtail is widely cultivated and its production has increased steadily to meet market demand. Many of the culture techniques described for the swordtail are readily adaptable to other species in the family as they share many morphological and biological traits. The natural geographic range of the common swordtail *Xiphophorus* sp. extends from Northern Mexico to the central and western parts of Guatemala and Honduras in central America. The species was introduced and has become established in southern Florida, California, the lake mead area of Arizona and Nevada, Hawaii, Canada, Africa, Sri Lanka, Australia and India. Established populations have also been reported in the United Kingdom (Dawes, 1991).

Nutrition play an important role in cultivable and ornamental fishes. Modern ornamental fish culture and breeding operations requires a continuous supply of nutritionally balanced, cost effective diets that provide all the essential nutrients to the fish. Prosperity and sustainable culture of ornamental fish depends on the use of nutritionally balanced, low cost and eco-friendly feeds. There are some methods of management used to achieve the reproductive phase in
aquatic organisms. Among them, the manipulation of the brood stock nutritional requirement plays a very important role for gametes and fry production (Bromage, 1995).

Dietary protein is a major role in aquaculture field. Fish meal is one of the most important source for aquaculture feed preparation. Tacon (1993) reported to feed ingredients such as rice bran, oil cakes, fish meal and other sources which have been used in traditional aquaculture as conventional feed can meet the nutritional requirements of culturable species. Now-a-days fishmeal is one of the most expensive ingredients of aquaculture diets. It is estimated that fish meal costs more than 50% of the variable costs of other ingredients (Woods, 1999). So profitability of production is significantly influenced by feed. Due to increasing the price of fish meal, it is desirable to replace fish meal with less expensive protein sources.

Many ornamental growers experienced that feed cost had a significant impact on their ornamental fish operations. For larger scale aquaculture feed production, feed and labour are typically among the largest operating costs (Kam et al., 2003). A number of plant source proteins have been evaluated for fish meal replacement in diets for a number of different species. Many authors have conducted experiments to reduce the amount of fish meal in fish diets and suitability of other plant or animal proteins (Nandeesha et al., 1998; Olevera-Novoa et al., 1998; Yang et al., 2004). The implicated ingredients nutrients include proteins, essential fatty acids polysaccharides, the antioxidant vitamins and some of the trace minerals like Zn and Se (Kiron et al., 1995; Sakai, 1999; Sealey and Gatlin, 1999). Ingredients from plant proteins (Eg. Spirulina, Soybean and alfalfa meal) and fibre are incorporated into diets for gold fish, koi carp and
herbivorous fishes (Chapman, 2000). An algae as a valuable alternative protein source particularly in tropical aquaculture, where adequate year round temperature are advantageous for continuous production (Mustafa and Nakagawa, 1995). Use of plant products as protein sources in fish feeds shows considerable applications potential for aquaculture worldwide (Yagci et al., 2009). Among micro algae *Cholerella* sp., *Scenedesmus* sp. and *Spirulina* sp. are the most frequently used in fish feed.

There are more than 3000 microalgae which can be cultured and among them only 100 species can be evaluated economically (Sukatar, 2002). In the scope of commercial algae production activities, *Spirulina* is one of the most commonly cultured microalga (Koru, 2009) and it has the most concentrated natural sources of nutrition for all animals. Early interest in *Spirulina* focused mainly on its potential as a source of protein and vitamins (James et al., 2006). The composition of commercial *Spirulina* powder has 60% protein, 20% carbohydrate, 5% fats, 7% minerals and 3-6% moisture making it a low-fat, low calorie and cholesterol-free source of protein. *Spirulina* protein has a balanced composition of amino acids with concentrations of methionine, tryptophan and other amino acids almost similar to those of casein although, this depends upon the culture media used (Habib et al., 2008).

*Spirulina* has high quality protein content which is more than other commonly used plant sources such as dry soybeans (35%), peanuts (25%) or grains (8-10%). A special value of *Spirulina* is that it is readily digestible due to the absence of cellulose in its cell walls and after 18 h > 85% of its protein is digested and assimilated (Sasson, 1997). *Spirulina* can be used as a partial supplementation or complete replacement for protein in aqua feeds and is a cheaper feed ingredient than other animal origin (Habib et al., 2008).
Spirulina is being widely studied, not only for nutritional reasons but also for its reported medicinal properties; thus, several studies have shown that Spirulina or its extracts could prevent or inhibit cancer in humans and animals, and recent works have indicated that this species has immuno-promoting effects (Qureshi and Ali, 1996; Hayakawa et al., 1997; Kim et al., 1998; Miranda et al., 1998; Mishima et al., 1998; Hirahashi et al., 2002; Subhashini et al., 2004). Spirulina contains a whole spectrum of natural mixed carotene and xanthophyll phyto pigments which, together with phycocyanin, seem to be related to its antioxidant activity (Miranda et al., 1998; Bhat and Madyastha, 2000; Pineiro Estrada et al., 2001). James et al., (2006) have reported the therapeutic effects of Spirulina as a growth promoter, probiotic and booster of the immune system in animals including fishes.

Various nutrients are tried at different levels on cultivable fishes to increase production. Fish meal is an ideal nutritional source of dietary protein and lipid for fish, but there is an urgent need to reduce the current total dependence of the feed industry upon this expensive and finite commodity of uncertain supply and cost. In this regard, single cell proteins, Spirulina hold promise as possible substitute for fish meal or feed additive along with fish meal by virtue of their ability to trigger growth and other physiological activities of fish (Nandeesha et al., 1998). Previous authors have studied the effect of protein rich Spirulina diet or its extract on growth and immune responses in various animals (Hayashi et al., 1994; Qureshi et al., 1995; Nandeesha et al., 1998); however, less attention has been paid to the ornamental fishes (Scaria et al., 2000; James et al., 2006). Nevertheless, a detailed studies on the effect of Spirulina on growth, reproduction,
coloration, metabolic rates and leucocytes count in ornamental fishes are scanty (James et al., 2006). Among the ornamental fishes, red swordtail *Xiphophorus helleri* is a delight in the aquarium with their dazzling good look and posturing behaviour. They are not only an economically important ornamental fish but also biologically interesting and thereby *X. helleri* is chosen for the doctoral work. The objectives of the present work are:

1. To study the effect of different levels of *Spirulina* on growth, coloration and digestive enzymes.

2. To study the effect of different levels of *Spirulina* on reproductive physiology of red swordtail.

3. To study compensatory role of *Spirulina* in relation to ration on growth, maintenance and reproduction in female gravid red swordtail.

4. To study the effect of *Spirulina* diet on respiratory metabolism in different stages of red swordtail and

5. To identify the time and duration of feeding *Spirulina* diet on growth, coloration and reproduction.