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Comparative Study on the Effect of Different Feeding Regimes on Chironomid Larvae Biomass and Biochemical Composition

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Abstract

In this study, the effect of diet food (soybeans, egg yolk and chicken manure) on biomass weight and body composition (the amount of protein, fat, moisture and ash) Chironomid larvae were examined. For this purpose, 2.5 grams of food per Coconut considered in the period, with three replicates and Chironomid larvae during the period of 15 days in plastic pans were kept in nutrition. The results showed that larval growth Chironomid was significantly influenced by the different diets. Between dietary treatments, larvae fed chicken manure treatment had highest average weight and best body composition (protein and fat) fed the treated egg yolk and no significant difference was found with other dietary treatments ($P<0.05$). As a result of this study showed that different diets influenced on the larval body weight and body composition. yolk eggs and poultry manure due to easy availability and low cost can be recommended for mass rearing of larvae Chironomid.

Keywords: Chironomid larvae, Body biochemical composition, Biomass, Different diet

Introduction

Chironomids, a group of insects belonging to order Diptera, phylum Arthropoda, are of benthic fauna living in aquatic ecosystems (Bernard, 2011). They have hemoglobin in their body and look red in color, so they are called blood worm (Madlen, 2005). Chironomid larvae is a good source of nutrients, vitamins and iron (Mclarney et al., 1974) and is used in frozen form in aquaculture and as a live food for many fish species, including sturgeons (Sahandy, 2011). Chironomid larvae nutritional value is very high and biochemical analyses showed that their dry weight contains 56% protein (De La Noue et al., 1985) and this has encouraged aquacultrists to use it. Chironomid larvae are known as an important food for many fish and invertebrates (Habibi et al., 1992; Tidwel et al., 1997). James et al. (1993) reported that use of chironomid resulted in minimization of culture period and costs of common carp feeding. Bodis et al. (2007) evaluated the efficacy of four feeding regimes on perch during the shifting from live food to dry food. Their results showed that feeding by chironomid resulted in the maximum growth rate and survival. Also, use of chironomid results in growth stimulation in fish and crustaceans (Tidwel et al, 1997). Nutrition is an important issue in chironomids' culture, because, it is possible that food shortage causes

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death, impaired growth, reproduction and survival in larvae (Ankley et al., 1993; Ankley et al., 1994). However, food items can significantly affect experimental results (Ristola, 1995). Based on available literatures, there are limited studies on the effect of feeding regimes on chironomid larvae biomass and biochemical composition. Therefore, the present study was conducted to compare different diets offered to chironomid larvae.

Materials and methods

This experiment was conducted over a 15-day period at aquaculture research center of Gorgan University of agricultural sciences and natural resources, Gorgan, Iran. Plastic tanks (diameter = 40 cm, depth = 20 cm) were used to investigate the effect of different diets on chironomid larvae. Under water heaters were used to maintain temperature at 26ºC. Water temperature was checked twice a day. To supply oxygen to the tanks, air pumps and air stones (5 cm in length) were used. Since it is hard to supply adult chironomids from the wild, it is necessary to provide a place for spawning. To this, 6 tanks were placed at different locations of the University, which each tank contained 20 g of wheat straw, 3 g of soybean meal and 15 cm water. Since chironomids spawn in the mediums rich in organic substance, they spawned in the provided tanks. The tanks were checked every day and cocoons that were attached to the tanks were transferred to laboratory. The eggs in each cocoon were counted using a loupe. Average number of eggs per cocoon was 500-1000. Three diets were studied including poultry manure, soybean meal and egg yolk. Each diet was offered at the rate of 2.5 g per cocoon. The experiment was conducted as triplicate under the photoperiod of 12: 12 (light: dark). Poultry manure was provided from the university poultry, dried under the sun light for 3 days and pulverized before use. Egg yolk was obtained by boiling eggs over 15 min and soybean meal was attained by pulverizing soybean oilcake. Three cocoons were added to each experimental tanks filled with dechlorinated tap water (26ºC). The eggs are hatched after 48-72 h incubation (Das et al., 2012). Feeding was started 48 h after incubation.

The first pupae were observed in the tanks fed by poultry manure at 15^{th} day. The larvae of all treatments were collected and weighed at this point. The larvae dry matter (at 105 ˚C for 24 h), crude protein (Kjeldahl apparatus, Nitrogen × 6.25), crude fat (extraction with petroleum ether by Soxhlet apparatus), ash (incineration at 525 ºC for 12 h) and nitrogen free extract [NFE = 100 – (moisture + crude ash + crude protein + crude fat + crude fiber)] were determined according to AOAC (2000). This experiment was conducted in completely randomized design with single factor. To analyze data, statistical software SPSS v. 16 was used. Data were analyzed using one way ANOVA and Duncan test. α was 0.05.

Results

Effect of different diets on chironomid larvae biomass is presented in Table 1. Also, effect of different diets on chironomid larvae biochemical composition is presented in Table 2. As the results of data analyses show, the quantity and quality of the diets offered during the larvae stage affected their biochemical composition (Table 1). There was a significant difference among the offered diets. Duncan test showed that the highest and lowest biomass was related to the larvae fed by poultry manure and soybean meal, respectively. The results showed that the maximum and minimum moisture content was related to the larvae fed by egg yolk and soybean meal, respectively, however, there was no significant difference in moisture content among the treatments ($P > 0.05$). The larvae fed by egg yolk had significantly higher protein and lipid compared to the other treatments ($P < 0.05$). The larvae fed by poultry manure and soybean meal had similar NFE being significantly higher that of the larvae fed by egg yolk ($P < 0.05$). There was no significant difference in ash content among the treatments ($P > 0.05$).

Discussion

Egg yolk, as a simple and available food, is a major source of vitamins and minerals being used to feed fish larvae newly absorbed their yolk sac. Food quality and quantity plays an important role in chironomid larvae growth (Johnson, 1980; Sankarpromal, 1991). According to table 1 and all of result in that and compare with last project my results are right. Sadler (1935) reared *Chironomus tentas* in the ponds fertilized by sheep manure, soybean meal and sheep manure + super phosphate fertilizer and observed that the best results was related to the pond fertilized by soybean meal. Jana and Pal (1990) reared chironomid larvae in the mediums containing different organic matter and found that the larvae production was higher in the medium enriched by rice bran, cow manure and poultry manure. Sahragard and Rafatifard (2006) found that poultry manure is the most suitable food for chironomids. Subamia (1986) used yeast, soybean oilcake, leaf meal, poultry manure, rice meal and fish meal to rear chironomid larvae and found that the highest production was related to the larvae fed by yeast, soybean oilcake and fish meal and all had similar production. According to the results obtained in the present study, it is suggested that poultry manure is the most suitable and available food for chironomid larvae production. According to table 2 and all of last project my results are right. Body biochemical composition (protein, lipid and ash) is largely depended to feeding regime (Philips et al., 1966; Cowey et al., 1974; Elliot, 1976; Dabrowska and Wojno, 1977; Yu et al., 1977; Atack et al., 1979). Bogut et al. (2007) analyzed *Chironomus plumosus* collected from wetland and found that it contained (dry weight) 87.9 % moisture, 55.7% protein, 9.7% lipid, 8.2% ash and 26.4% NFE.

Based on the results obtained from the present study and previous ones, it could be concluded that use of poultry manure, soybean and egg yolk results in difference in chironomid larvae biomass and biochemical composition. However, most of the present results suggest the positive effect of poultry manure as the most suitable food for chironomid larvae. Also, use of egg yolk results in increase in protein and lipid, which are the most important factors for aquatic animals' growth and reproduction. Therefore, the present results will help to increase economic efficiency in commercial production of chironomid larvae.

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Table 1. Average biomass (g) of chironomid larvae at the experiment termination

Feeding regime	Maximum (g)	Minimum (g)	Biomass
Poultry manure	5.75	5.01	5.32 ± 0.38^{a}
Soybean meal	4.11	3.56	3.84 ± 0.27^{b}
Egg yolk	4.28	3.58	3.93 ± 0.49^{b}

Different superscript letters show significant difference ($P < 0.05$).

Table 2. The effect of different diets on chironomid larvae biochemical composition

Body biochemical composition (%)					
Feeding regime	Moisture	Protein	Lipid	NFE	Ash
Poultry manure	88.63 ± 0.47^{ab}	57.03 ± 0.15^{b}	8.76 ± 0.30^{c}	26.03 ± 0.25^{a}	7.86 ± 0.60^{a}
Soybean meal	87.96 ± 0.49^{b}	56.10 ± 0.20^{c}	10.06 ± 0.25^{b}	26.96 ± 0.11^{a}	6.86 ± 0.15^{a}
Egg yolk	89.16 ± 0.35^{a}	61.06 ± 0.25^{a}	15.56 ± 0.40^{a}	17.30 ± 0.26^{b}	6.06 ± 0.25^{a}

Different superscript letters show significant difference ($P < 0.05$).