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Natural food production for aquaculture: Cultivation and nutrition of Chironomid larvae (Insecta, Diptera)

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Abstract. In this study, we did not prepared fly room and obtained flies egg from environment (as a mixture of species). A number of 10 trays with 120 cm^2 scale filled with 2–3 cm dechlorinate tap water were used. Trays were located in special places with electrical lamp on the top of them at night. Flies have positive phototropism so that high number of adult flies were attracted by light. After night, at morning, trays were transferred to the incubation room. Eggs are macroscopic and visible. Incubation room has tanks with 20 liters capacity that filled with water up to 15 cm of tank height. All trays water with eggs was transferred to the tanks. Base of tanks was covered with small gravel. After 1-2 days at 18-28°C, eggs would be hatched and about 2300 larvae would be produced. After eggs hatching, feeding step would be start. We used bakery yeast (*Saccharomyces cerevisiae*) as food. We mixed 0.2g of yeast with 1 liter water and this blend was used for one week. Incubation tanks were aerated calm; air stones were used for aeration because of the need of significant allocation of oxygen to the water. At collection of insect larvae, air stone has to be removed from the breeding tank. After 11–12 days 'worms' were collected with net and used as live food for *Huso huso*. Red color of this 'blood worm' attracts fish larvae which eat it with the specific appetite. In some cases, for high density production, a fly room is necessary and this can be prepared with wood and net. In this way larvae production is possible all year long.
Key word: Chironimid flies, larvae, tray, live food, incubation room, yeast, algae, Iran.

Introduction. In recent decades, two general approaches using invertebrates are being employed worldwide to conduct biological assessments of aquatic systems (Silva et al 2008; Stoian et al 2009; Badea et al 2010; Marin et al 2011; Raescu et al 2011). One is taxonomic, and the other is functional. The first involve measurements, such as species density, specific diversity or richness, while the second is focused in food webs and energy flow (Cummins et al 2005). According to Cummins & Klug (1979), the use of the functional approach may be more adequate if the goal is to characterize ecosystem condition. Flies play an important role in water ecosystems environment and one important group is that of Chironomidae (Shaw 1980; Habib et al 1992; Fernando 1994; Yussof et al 1996; Tidwell et al 1997). Chironomidae family has more than 10,000 species all over the world (Langton). The Family Chironomidae has an important role in aquatic food webs, representing a major link between producers, such as phytoplankton and benthic algae, and secondary consumers (Tokeshi 1995). These organisms can occupy important positions in the trophic dynamics of aquatic ecosystems, due to their numeric abundance and role in nutrient cycling. The chironomids alter the composition of fine organic matter (<1mm) and supply important subsidies for predators (Silva et al 2008). Moreover, due to their long life cycle and low mobility, chironomids integrate various biological processes and may be used as indicators of environmental conditions (Odum 1988; Kuhlmann et al 2001; Silva et al 2008; Ekrem 2000).

Live food production in aquaculture industry is one of the most important sectors that up to now so many studies had done about it. Chironomid larvae, called also blood worms, are well known fresh water organisms due to their invaluable significance in

aquaculture. These organisms are excellent and widely used live food for fish larvae especially for sturgeon fish larvae. The red color of their body is because of hemoglobin that abound in their organism and for this reason these larvae are the best resource of iron. Nowadays, Southeast Asian countries, especially China, are among the larger blood worm producers. This industry is one of the most expensive industries and needs a lot of professionalism. The present study was initiated in order to present the principles of culture of Chironomid fly larvae.

Material, Methods, Results. In this study, we did not prepared fly room and obtained flies egg from environment (as a mixture of species). A number of 10 trays with 120 cm^2 scale filled with 2–3 cm dechlorinate tap water were used. In tropical climates flies spawn in water with low depth. Maybe this is because of high production that happens in low depth water. Trays were located in special places with electrical lamp on the top of them at night. Flies have positive phototropism so that high number of adult flies were attracted by light. After night, at morning, trays were transferred to the incubation room. Eggs are macroscopic and visible. Incubation room has tanks with 20 liters capacity that filled with water up to 15 cm of tank height. All trays water with eggs was transferred to the tanks. Base of tanks was covered with small gravel.

After 1-2 days at 18-28°C, eggs would be hatched and about 2300 larvae would be produced. After eggs hatching, feeding step would be start. We used bakery yeast (*S. cerevisiae*) as food. We mixed 0.2g of yeast with 1 liter water and this blend was used for a week.

Incubation tanks were aerated calm; air stones were used for aeration because of the need of significant allocation of oxygen to the water. At collection of insect larvae, air stone has to be removed from the breeding tank.

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In some cases, for high density production, a fly room is necessary and this can be prepared with wood and net. In this way larvae production is possible all year long.

Discussion. Chironomid breeding and cultivation in sturgeon fish farms could be good idea because of the nutritional price of this organism. Like artemia and rotifers, this live food can be good vector for some specific nutrients of fish diet. Protein is the important ingredient that all fish larvae need to eat. High protein of this worm makes them an excellent choice for sturgeon fish larvae as starter feed. Today 'blood worms' are produced in Asia and packed for export to many countries as an ornamental fish feed.

Recent studies about Chironomids nutrition introduce new methods for breeding of this 'worm'. There are different diets that can be used for Chironomid feeding: freshwater microalgae (*Isochrysis* sp., *Chlorella* sp), yeast and artificial diets. In this study we used yeast (*S. cerevisiae*). In another study, Habashy (2005) used different diets that contain yeast, algae and Tetramin flake food that are explained in Table 1.

Table 1

Chironomids food composition expressed in percentages of organic matter (Habashy 2005)

Parameters	*Types of food*		
	Tetramin	Algae	Yeast
Organic matter	87.6	95.8	93.7
Protein	37.6	36.8	42.3
Lipid	6.3	9.6	2.2
Carbohydrates	30.1	42.6	41.1
Energy content (KJ/g)	14.4	17.7	15.5

Sahandi & Jafaryan (2011), reported that use of blend of algae and yeast improved growth rate of rotifer (*Brachionus plicatilis*); we propose for the future similar research on Chironomid nutrition. Microalgae (*Scenedesmus sp.*), yeast and Tetramin flakes were used separately in Habashy (2005); the last diet of the three diets tested showed the best results. Mclarney et al (1974) documented that the first known Chironomidae species cultured in South-East Asia was the javanese *Tanypus crux* (Wiedemann). However, the most valuable information on Chironomid cultivation comes from the study of Ashe & Cranston (1990); the best cultivation environment and food are the most important elements in Chironomid culture. Their growth period is related to their environmental features (Murray 1976). The other important sector is quantity and availability of food (Mackey 1977ab; Vos et al 2000). Chironomid larvae are rich resource of protein (De la Noue & Choubert 1985), lipid, minerals and vitamins (Habib et al 1997; Mclarney et al 1974). This 'worm' could be use as dietary supplement. Sugden (1973) reported that Chironomid larvae contain 56% protein and has about 73.6% digestibility. This 'blood worm' could be also a good source of food for crustaceans (Tidwell et al 1997).

References

Ashe P., Cranston P. S., 1990 Family Chironomidae. In: Soós, A. & Papp, L. (Eds) Catalogue of Palaearctic Diptera. Volume 2. Psychodidae – Chironomidae. Akadémiai Kiadó, Budapest, pp. 113–355.

Badea A. B., Gagyi-Palffy A., Stoian L. C., Stan G., 2010 Preliminary studies of quality assessment of aquatic environments from Cluj suburban areas, based on some invertebrates bioindicators and chemical indicators. AACL Bioflux **3**(1):35-41.

Cummins K. W., Klug M. J., 1979 Feeding ecology on stream invertebrates. Annual Review of Ecology and Systematic **10**:147-172.

Cummins K. W., Merrit R. W., Andrade C. N., 2005 The use of invertebrate functional groups to characterize ecosystem attributes in selected streams and rivers in south Brazil. Studies on Neotropical Fauna and Environment **40**:71-90.

De la Noue J., Choubert G., 1985 Apparent digestibility of invertebrate biomass by rainbow trout. Aquaculture **50**:103-112.

Ekrem T., 2000 Chironomid types at Muséum National d'Histoire Naturelle, Paris (Meigen collection not included). Chironomus Newsletter on Chironomidae Research **13**: 15–19.

Fernando C. H., 1994 Zooplankton, fish and fisheries in tropical freshwaters Hydrobiologia **272**:105-123.

Habashy M. M., 2005 Culture of Chironomidae larvae (Insecta-Diptera Chironomidae) under different feeding systems. Egyptian Journal of Aquatic Research **31**(2):403-418.

Habib M. A. B., Yossuf F. M., Phang S. M., Ang K. J., Mohamed S., 1997 Nutritional values of chironimid Larvae grown in palm oil mill effluent and algal culture. Aquaculture **158**:95-105.

Habib M. A. B., Ali M. M., Dey N., 1992 Culture of chironimid larvae in artificial medium. Bangladesh Journal of Fisheries **20**:63-70.

Kuhlmann M. L., Brandimarte A. L., Shimizu G. Y., Anaya M., 2001 Invertebrados bentônicos como indicadores de impactos antrópicos sobre ecossistemas aquáticos continentais. 237-248. In: N. B. Maia, H. L. Martos, W. Barrella, (Eds). Indicadores ambientais: conceitos e aplicações. EDUC/COMPED/INEP, São Paulo, 285 p.

Langton P. H., *Smittia scutellosa* Caspers, 1988, (Diptera, Chironomidae) new to France. Dipterists Digest **12**:6.

Mackey A. P., 1977a Growth and development of larval chironomidae. Oikos **28**:270-275.

Mackey A. P., 1977b Quantitative studies on the chironomidae (Diptera) of the River Thames and Kennet. 111. The Nuphar Zone. Archive Hydrobiologia **79**:62-102.

Marin A. A., Dumbrava-Dodoaca M., Petrovici M., Herlo G., 2011 The human impact on benthic community structure and dynamics of different ecosystems from Lunca Muresului Nature Park (West of Romania). AACL Bioflux **4**(1):72-78.

Mclarney W. O., Henderson S., Sherman M. M., 1974 A new method for culturing *Chironomus tentans* Fabricius larvae using burlap substrate in fertilized pools. Aquaculture **4**:267-276.
Murray D. A., 1976 Thienemannimyia pseudocarnea n. sp., a palaearctic species of the Tanypodinae (Diptera: Chironomidae). Entomologica Scandinavica **7**:191–194.
Odum E. P., 1988 Ecologia. Guanabara, Rio de Janeiro, 434 p. Palaearctic Diptera. Volume 2. Psychodidae – Chironomidae. Akadémiai Kiadó, Budapest, pp. 113–355.
Raescu C.-S., Dumbrava-Dodoaca M., Petrovici M., 2011 Macrozoobenthic community structure and dynamics in Cerna River (western Romania). AACL Bioflux **4**(1):79-87.
Sahandi J., Jafaryan H., 2011 Rotifer (*Brachionus plicatilis*) culture in batch system with suspension of algae (*Nannochloropsis oculata*) and bakery yeast (*Saccharomyces cerevisiae*). AACL Bioflux **4**(4):526-529.
Silva F. L., Ruiz S. S., Bochini G. L., Moreira D. C., 2008 Functional feeding habits of Chironomidae larvae (Insecta, Diptera) in a lotic system from Midwestern region of São Paulo State, Brazil. Pan-American Journal of Aquatic Sciences **3**(2):135-141.
Shaw M. K. K., 1980 Chironomid farming - a means of recycling farm manure and potentially reducing water pollution in Hong Kong. Aquaculture **21**:155-163.
Stoian L. C., Gagyi-Palffy A., Stan G., 2009 Preliminary aspects regarding the use of some invertebrate bioindicator species in the ecological study of an aquatic lotic ecosystem. AACL Bioflux **2**(3):331-337.
Sugden L. G., 1973 Feeding ecology of Pintail, Gadwall, American Wigeon and Lesser Scaup ducklings. Canadian Wildlife Services Report **24**:45.
Tidwell J. H., Schulmeister C. M., Coyle S., 1997 Growth, survival, and biochemical composition of freshwater prawns *Macrobrachium rosenbergii* fed natural food organisms under controlled conditions. Journal of the World Aquaculture Society **28**(2):123-132.
Tokeshi M., 1995 Production ecology. Pp.269-296. In: Armitage, P. D., Cranston, P. S. & Pinder, L. C. V. (Eds). The Chironomidae: biology and ecology of non-biting midges. Chapman & Hall, London, 571 p.
Vos J. H., Ooijevaar M. A. G., Postma J. E., Admiraal W., 2000 Interaction between food availability and food quality during growth of early in star chironimid larvae. Journal of North American Benthological Society **19**(1):158-168.
Yussof M. F., Om A. D., Cheah S. H., 1996 Use of agro-industrial effluent in augmenting micro algae production and fish fry growth in hatchery tanks. Journal of Aquaculture in the Tropics **11**:119-126.

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