Pak. j. sci. ind. res. Ser. B: biol. sci. 2014 **57** (1) 46-50

Utilization of Poultry Excreta for High Density Production of *Daphnia carinata* (King 1853): Cost Effective and Environmental Friendly Technique

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(received October 2, 2012; revised July 8, 2013; accepted July 10, 2013)

Abstract. *Daphnia carinata* was cultured for 21 days using poultry excreta to fertilise the medium at the rate of 500 ppt and maximum density of 5633.32 ± 88 Ind./L was recorded on 11th day of culture in the tanks, where, the feed was administered with 25% dosage followed by 50% dosage (1894.44 ± 9.68 Ind./L) and 75% dosage (1103.55 ± 17.80 Ind./L) of the initial dosage (500 ppt). A 50% renewal of the medium thrice a week proved optimal for the population development. The water analysis showed that the temperature range of 28 ± 2 °C and pH of 6-7 was conducive for optimal growth of *D. carinata.*

Keywords. *Daphnia carinata,* chicken manure, live feed, fish farming, aquaculture

Introduction

Mass culture of zooplankton of required quality and quantity within a short time period has been the subject of many investigations during recent years and is one of the important basic requirements for scientific management in the fish farms. An important factor in the success of aquaculture is the continuous availability of suitable food, at a reasonable cost. It is well known that the mass culture of zooplankton in high density is a basic necessity for fish production. Most fish and prawn species rely on zooplankton at some stage of their life span, while some others are exclusively zooplankton feeders throughout their life (Kumar *et al.,* 2005). The extended studies have further revealed that production of zooplankton is also desirable for consumption so as to obtain optimum growth of developmental stages until harvesting under fish culture in addition to controlled and coordinated supplementary feedings. Several studies document, why natural food is indispensable in the early life history of fish (Kumar *et al.,* 2005; Adeyemo *et. al.,* 1994; Sorgeloos *et al*., 1980). Zooplankton constitutes an important food source in both nursery ponds and outdoor enclosure systems (Jana and Chakrabarti, 1997). There is a growing need to mass culture of indigenous live food organisms for use in fish and shrimp hatcheries. A wide range of live and inert feed can successfully be used in culturing live feed organisms. Poultry manure; a cheap food, available worldwide, will be helpful in reducing the cost of expenditures on live feed production.

The cladoceran *Daphnia carinata* (Class: Crustacea, Order: Cladocera) popularly known as water flea is a preferable food item for many freshwater larval fishes. This group is one of the dominant groups of freshwater zooplankton and contributes significantly, to the productivity and energy flow in aquatic ecosystem. They are autotrophic producers as well as feed on detritus (SureshKumar, 2000). The ability of cladocerans to ingest food of wider range and their higher filtering rates give them a better competitive edge over the rotifers. *Daphnia* species with the help of specialised combs of setae on the thoracic appendages can utilise algae, bacteria, fungi, protozoans and organic debris and even small food particles of 1-60 µm range (Srivastava *et al.,* 2006). They contain many essential amino acids required for fish and shrimp larvae. These nutrients occur in them far above the level recommended for larvae (Kibria *et al*., 1997). Being natural food of fish and prawn larvae, cladocerans are collected from natural resources for use as diet for the larvae of ornamental fish in many hatcheries. Altaff *et al.* (2002) and Kahan (1982) opined that this is an unreliable source for commercial production in quality and quantity due to uncontrolled fluctuation and drawbacks of collecting method. Further, they may introduce harmful organisms in the hatchery. Waste water cultured *Daphnia magna*

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supports survival and growth of rainbow trout larvae and are mainly used alive or preserved as food for fish in aquaculture (Kumar *et al.,* 2005). Daphnids play an important role in the dynamics of inorganic turbidity in large tropical reservoir and produce lose faeces that disaggregate easily after release (Filella *et al*., 2008).

One of the major problems associated with the culture of zooplankton is its unstable nature, often exhibiting a rapid population decrease immediately after attaining a peak density (Srivastava *et al.,* 2006; Jana and Chakrabarti, 1997). The unstable nature of zooplankton populations is a major setback for mass culture because sustained production throughout year cannot be achieved. Use of manure provided at different dosages and frequencies may significantly, influence the water quality and assist in defining the optimal conditions required for continuous and high density culture of cladocerans. In this context experiments were carried out on mass culture of *D. carinata* using poultry excreta which will make it a cheap and easily available food source to the fish culturists. Hence, the main focus of this study was to check the feasibility of using chicken manure and the effect of different feeding rates for fertilising the medium to culture *D. carinata,* which is a cost effective and eco-friendly approach.

Materials and Methods

Chicken manure was collected from a local broiler chicken shop and was dried for two days to remove the moisture and stored in plastic jars for further use. Chicken manure was micronised by grinding and required quantity was dissolved in distilled water to get suspensions of 500 ppt for fertilisation of culture medium. Micronisation of chicken manure is necessary for an efficient filtration of the suspended particles by daphnids. Zooplankton sample was collected from fish rearing pond at Centre for Aquaculture Research and Extension (CARE), St. Xaviers College Palayamkottai, Tamilnadu, India and was brought to the laboratory with least disturbance. The adult *Daphnia carinata* were separated using binocular dissection microscope based on the key characters outlined by Altaff (2004). The experimental aquarium tanks of 50 L capacity were filled with 40 L of filtered water and were fertilised with chicken manure at the rate of 500 ppt (0.5 g in 1 litre of water). The culture water used in all experiments was tap water, previously aerated for 24 h to dechlorinate the water (Altaff and Mehrajuddin, 2010). The tanks were arranged in triplicate. *D. carinata* were inoculated in each experimental tank after 4 days at the rate of 50 ± 5 Ind./L containing both adults and neonates. The culture experiment was conducted for 21 days. To avoid anaerobic conditions in the medium, the sediment (unconsumed food, faeces, and pseudofaeces) was siphoned from the bottom three times a week. Excessive fouling was also removed from the walls of the tanks. Water change was carried out at every 3 days interval by removing 50% of the water. Food was administered at the rate of 25%, 50% and 75% of the initial dosage (500 ppt) after every two days.

Wet weight of the animals was determined after draining 10 L of the culture medium over a nylon gauze of 200 µm mesh size and washed several times to remove other debris. The remaining water was absorbed using tissue paper and the animals were weighed on a digital balance with 1µg sensitivity. Population density was estimated by counting samples on 3rd, 7th, 9th, 11th, 14th, 17th and 21st day of culture taken at random with one litre beaker, after mixing the culture volume. Sub samples of 100 mL and then 10 mL were drawn from these samples. Samples were immobilised using alcohol and counting was carried out using Sedgwick Rafter cell under a binocular dissection microscope. Results were expressed as number of individuals per litre (Ind./L).

Results and Discussion

In general, density of *D. carinata* was significantly, higher (5633.32 ± 88 Ind./L) in tanks, where, 25% dosage was given/supplied, while, the least (1310 ± 15.27 Ind./L) was found in 75% dosage. The values of most of the physical and chemical parameters recorded in the present study were within the desirable range. Atmospheric and water temperature during culture period was 28 ± 2 °C, and 26 ± 2 °C, respectively, while, pH ranged between 6-7 in the present experimental conditions. Protozoans reached to a peak density on 7th day of culture (40.33 ± 1.83 Ind./mL) and represented mostly by *Paramecium* sp., *Euglena* sp., and *Cryptodifflugia* sp. The population of *D. carinata* ranged between 50 ± 5 and 5633.32 ± 88 Ind./L during the culture period of 21 days (Fig. 1). Maximum density was observed on the 11th day of the culture (5633.32 ± 88 Ind./L). The wet weight (mg) obtained during different days of culture is summarised in Fig. 2. The highest wet weight (1156.7 mg/10L) was obtained on the 11th day of the culture period. A 50% renewal of the medium thrice a week proved optimal for the population development. Frequent application of low doses of

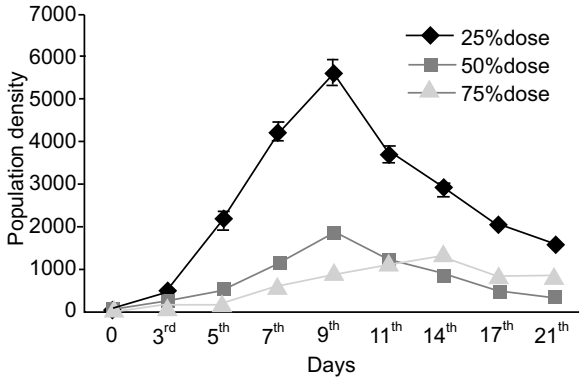

Fig. 1. Population density of *Daphnia carinata* during different days of culture at different feeding rates (Mean ± SE).

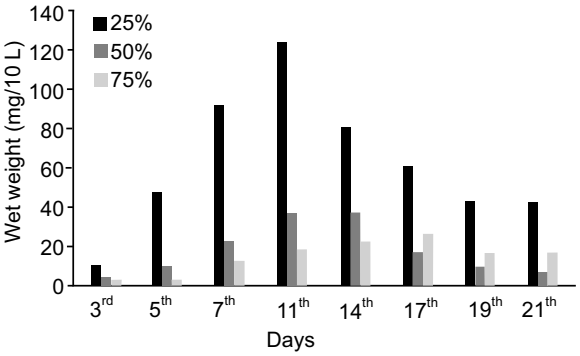

Fig. 2. Wet weight obtained during different days of culture period (Mean ± SE).

poultry excreta resulted in high density production of *D. carinata* and good water quality. The density of *D. carinata* increased steadily and reached to its peak (5633.32 ± 88.19 Ind./L) on the 11th day of culture, and thereafter, the production declined, such population dynamic was also reported by Pangano *et al.* (2000). Who observed maximium density on 7th day. It is interesting to note that the population of protozoans increased during the course of the culture and peaked (40.33 ± 1.83 Ind./mL) on the 7th day of culture and declined (28.33 ± 0.57) on the 14th day (Fig. 3). The advantage of culturing *D. carinata* by frequently applying low doses of poultry waste might provide sufficient food to the animals as well as maintaining the favourable water quality, leading to fast growth, early maturation and relatively long life span. Ammonia and nitrite are the main nitrogen compounds that are considered risk factors in the growth of crustaceans, when the manure decays and its nitrification produces acidity. Water in which high densities of *Daphnia* occurred exerts allelopathic effects on the growth and reproduction of smaller

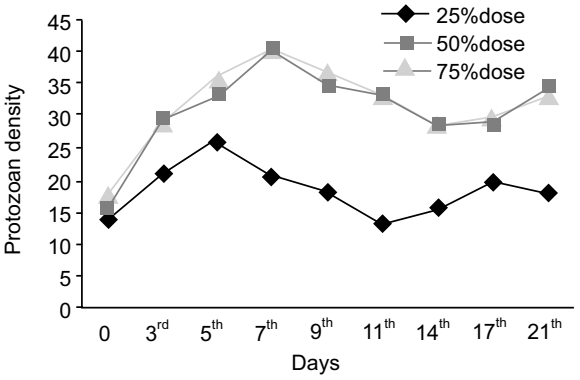

Fig. 3. Protozoan density (Ind./L) during different days in the culture medium fertilised with different concentrations of poultry excreta (Mean ± SE).

daphnids, probably through chemical compounds released into the medium that are not the products of food metabolism (Martínez-jerónimo *et al.,* 2007). Hence, higher concentration of the manure used to fertilise the water will lead to more acidic conditions rendering unfavourable conditions. Therefore, it suggests that frequent application of low doses might be best for achieving high density and continuous culture of *D. carinata*.

The physicochemical parameters appear to play an important role in the successful culture of cladocera. Tay *et al*. (1991) observed that there is no report to suggest the relationship between the physicochemical parameters and physiological process of zooplankton. Shrigur and Indulkar (1987) proposed the range of water temperature between 27-31 ºC for optimum growth of *Moina micrura*. In the present study, temperature range of 28 ± 2 ºC appeared to produce optimum density of cladocerans. It has been reported by Tay *et al*. (1991) that the upper lethal limit, where 50% mortalities of cladocerans occur is close to 40 ºC.

Dissolved oxygen content of the culture medium is another important factor for the growth of population. In the present study, in all culture media dissolved oxygen level of 4-5 mg/L was maintained through aeration (debris was removed on alternate days and by using aerator) and fertilisation of the medium at regular intervals. DePauw *et al*. (1981) also reported similar results, where dissolved oxygen level of culture medium for *D. magna* was above 5 mg/L with aeration. Tay *et al*. (1991) have stressed that aeration is an important culturing parameter and correlation studies showed that dissolved oxygen decrease with organic loading of the media (Sivakumar, 2005).

Usually, when environmental conditions are favourable (adequate food quality and quantity, population density, temperature and photoperiod), the progeny constitutes parthenogenetic females, which are clones of mother. When the environmental conditions become unfavourable asexual reproduction changes to sexual, which leads to the production of males and females, eventually leading to formation of resting eggs that enter into diapause, until the conditions become favourable again (Martínez-jerónimo *et al.,* 2007). Population density can exert indirect effects, modifying feeding conditions by releasing and accumulating chemical substances, or through behavioural signs. *D. carinata* can be grown to a high density using chicken manure. However, an absolute prerequisite is the exact dosing of chicken manure at different densities during the culture period. Overfeeding can quickly cause problems in water quality, regardless of the type of the media used, therefore, it should be started with small amounts of feed or fertiliser and slowly increase the amount used as the density increases. Dried algae in some cases are also excellent food but they are too expensive to be used in large scale systems (DePauw *et al.,* 1980). It is evident from the results that it is possible to mass culture *D. carinata* using chicken manure which is cost effective, thereby, reducing the expenditures on the seed production in hatcheries.

Acknowledgement

The authors are thankful to ICAR-NAIP for providing funds to carry out this research work under the project (F. No.1 (5)/2007-NAIP dt. 22 Aug. 2008).

References

Adeyemo, A. A., Oladosu, G. A., Ayinla, A. O. 1994. Growth and survival of fry African catfish species, *Clarias gariepinus* Burchell, *Heterobranchus bidorsalis* Geroffey and *Heteroclarias* reared on *Moina dubia* in comparison with other first feed sources. *Aquaculture*, **119:** 41-45.

Altaff, K., Mehrajuddin, W. 2010. Culture of *Ceriodaphnia cornuta* using chicken manure as fertilizer: Conversion of waste product into highly nutritive animal protein. *Pakistan Journal of Scientific and Industrial Research*, **53:** 89-92.

Altaff, K. 2004. *A Manual of Zooplankton,* 155 pp., University Grants Commission, New Delhi, India.

Altaff, K., Raghunathan, M.B., Kumar, S.R., Suriyanarayana, M.M. 2002. Harvest of zooplankton live food for ornamental fishes from natural ponds in north Chennai, Tamilnadu. *Indian Hydrobiologia,* **5:** 115-118.

DePauw, N., Lawreys, P., Morales, J. 1981. Mass cultivation of *Daphnia magna* (Straus) on ricebran. *Aquaculture*, **25:** 141-152.

DePauw, N., De Leenheer, L. Jr., Lawreys, P., Morales, J., Reartes, J. 1980. Cul-Pisciculture d' algues et d'invertebres sur Dechets agricoles, In. *La Pisciculture en Etang,* R. Billard (ed.), pp.189-214, INRA, Public, Paris, France.

Jana, B.B., Chakrabarthi, L. 1997. Effect of manuring rate on in situ production of zooplankton *Daphnia carinata*. *Aquaculture,* **156:** 85-99.

Kahan, D. 1982. Mass cultivation of food organisms in hatcheries problems and proposed solutions. *Proceedings of the Symposium on Coastal Aquaculture*, vol. **1**, pp. 314-320, Prawn Culture, Marine Biology Association of India.

Kibria, G., Nugegoda, D., Faircloug, R., Lam, P., Bradly, A. 1997. Zooplankton: It's biochemistry and significance in aquaculture. *Naga, the ICLARM Quarterly,* **20:** 8-14.

Kumar, S., Srivastava, A., Chakrabarti, R. 2005. Study of digestive proteinases and proteinase inhibitors of *Daphnia carinata*. *Aquaculture*, **243:** 367-372.

Martínez-jerónimo, F., Rodríguez-Estrada, J., Villaseñor-Córdova, R. 2007. Effect of culture density and volume on *Moina micrura* (Kruz, 1874) reproduction and sex ratio in the progeny. *Hydrobiologia,* **594:** 69-73.

Filella, M., Rellstab, C., Chanudet, V., Spaak, P. 2008. Effect of filter feeder *Daphnia* on the particle size distribution of inorganic colloids in freshwaters. *Water Research*, **42:** 1919-1924.

Pangano, M., Saint-Jean, L., Arfi, R., Boury, M., Sheap, H. 2000. Population growth capacities and regulatory factors in monospecific culture of the cladoceran *Moina micrura* and *Diaphanasoma excisum* and the copepod, *Thermocyclops decipiens* from cote d' Ivoire (West Africa). *Aquatic Living Resources,* **13:** 163-172.

Shrivastava, A., Rathore, R.M., Chakrabarthi, R. 2006. Effects of four different doses of organic manures in the production of *Ceriodaphnia cornuta*. *Bioresource Technology*, **97:** 1036-1040.

Shirgur, G.A., Indulkar, S.T. 1987. Continuous mass culture of cladoceran *Moina micrura* in plastic pool for daily exploitation. *Punjab Fishries Bulletin*, **11:** 43-48.

Sivakumar, K. 2005. Freshwater Fish and Prawn Larval Rearing Using Indigenous Live-Feed. *Ph. D. Thesis*, 147 pp., University of Madras, India.

Sorgeloos, P. 1980. The use of the brine shrimp *Artemia* in aquaculture. In: *The Brine shrimp Artemia: Ecology, Culturing and Use in Aquaculture*, G. Persoone, P. Soregeloos, O. Roels and E. Jaspers (eds.), vol. **3**, pp. 25-46, Wetteren, University Press, Belgium.

Suresh Kumar, R. 2000. Studies on Freshwater cladocerans for use as Live-Feed in Aquaculture. *Ph.D. Thesis,* 158 pp., University of Madras, India.

Tay, S.H., Rajbanshi, V.K., Ho, W.H., Chew, J., Yap, E.A. 1991. Culture of cladoceran *Moina micrura* Kurz using agroindustrial waste. In: *Proceedings of the 4th Asian, Fish Nutrition Workshop,* De Silva, S.S. (ed.), vol. **5,** pp. 135-141, Asian Fishries Society Special Publication, Manila, Phillipines.