Effects of garlic (*Allium sativum* L) extract on growth, feed utilization and carcass composition in *Mugil cephalus* (Linnaeus, 1758) larvae

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Introduction

Various extracts from herbs and spices are reported to improve animal performance by stimulating action on gut secretions or by having a direct bactericidal effect on gut micro flora. Furthermore the active principles of the herb in the diets induce the secretion of the digestive enzymes and the growth promoter in herbs induces high protein synthesis (Khalil *et al.*, 2001; Citarasu, 2010). Garlic is an important medicinal herb extensively cultivated in many countries and has played an important dietary function as well as medicinal role for centuries. Several studies have demonstrated the positive effect of garlic inclusion in fish feed on the growth performance of various species. Different dosages of garlic in diet used to feed *A. ruthensis* (Lee *et al.*, 2012), *Huso huso* (Ebrahim Dorche *et al.*, 2013), *Litopenaeus vannami* (Javadzadeh *et al.*, 2012) and *O. niloticus* (Shalaby *et al.*, 2006) exhibited better growth. Garlic as a natural product may be useful in the diet of *Mugil cephalus* which is one of the commercially important culture fish in Iran because it is euryhaline, fast-growing, and disease resistant (Yousefian *et al.*, 2009).

Until now, no trial has been conducted to study the effects of dietary garlic extract on growth of grey mullet (*M. cephalus*) This study was therefore designed to investigate the effects of garlic on growth, feed utilization and carcass composition of *M. cephalus* larvae with the aim of ascertaining the importance and level of garlic supplementation in fish feeds especially in *M. cephalus.*

Materials and methods

In mid-February, larvae of *M. cephalus* (average wet weight 0.45±0.11 g) captured from the coastal waters of Chabahar port, were transferred to the Research Institute of Fisheries,

Chabahar, Iran. Then grey mullet larvae (n=360) were divided into four equal groups. Three replicates were used for each group and randomly assigned to 12 plastic tanks each 20 L in volume. The control group (1) was fed with the basal diet and the remaining groups (2-4) were fed with 0.5% (diet 2.0 kg +100 mL garlic extract +300 mL distilled water), 1.0% (diet 2.0 kg+200 mL garlic extract + 300 mL distilled water) and 3.0% (diet 2.0 kg+600 mL garlic extract +300 mL distilled water) of garlic extract in diets, respectively (Lee *et al.*, 2012).The study was conducted over a period of 30 days to evaluate the efficiency of garlic extract in promoting growth and carcass composition of grey mullet. Chemical analysis of fish whole body were performed by the standard procedure of AOAC (1995).

All measurements were repeated twice. Data were evaluated using one-way analysis of variance (ANOVA). Groups were considered to be significantly different if $p<0.05$. When a significant *F* value was obtained for ANOVA the differences between all groups were tested by using Duncan multiple comparisons test. All statistics were performed using SPSS for windows versions 16. Data are reported as means±standard Error.

Results and discussions

The results of different concentrations of garlic extract on growth parameters are shown in Table 1 and 2.

The final whole body proximate composition of grey mullet fed diets with or without garlic extract for 30 days is shown in Table 3.

In the present study, larvae fed 3% concentration of garlic extract in diet (group 4) exhibited the highest SGR, BWI, and PPR and PER among the all the groups after 30 days of culture (Tables 1 and 2). From these results, it was concluded that the addition of 3% garlic extract to the commercial diet was optimal for growth performance in grey mullet. Lee *et al.* (2006) reported significant increased feed efficiency (79.1%), protein efficiency ratio (1.50) and specific growth rate (11.8%) in *A. ruthensis* which were fed 0.5% garlic extract in the diet which was in agreement with the results, of the present study.

Table 1: Average weight, total length[a], and percent body weight increase (BWI) in *Mugil cephalus* fed diets with or without garlic extract for 30 days.

Group	Average weight (g)	Average length (cm)	BWI (%)[b]
1	0.55±0.07 [a]	3.35± 0.11 [a]	25.17±19.70 [a]
2	0.72± 0.09 [b]	3.83± 0.11 [b]	67.52± 24.40 [b]
3	0.77±0.04 [b]	3.90± 0.07 [b]	76.91± 13.44 [c]
4	0.78± 0.05 [b]	4.04± 0.14 [b]	85.13± 17.19 [d]

Within columns values with different superscripts are significantly different (p<0.05). a) Initial weight and length of grey mullet larvae 0.44 g ±0.11 SE and 3.40 cm ± 0.05 SE respectively. b) Body weight increase (%) = (final weight (g) - initial weight (g)) ×100/ final weight (g). Group 1 (Control group) was fed with basal diet and the remaining groups (2-4) were fed with 0.5,1 and 3% concentrations of garlic extract in diets respectively. Values are Mean ± SE (n= 60).

Table 2: Specific growth rate (SGR), feed conversion ratio (FCR), condition factor (CF), protein efficiency ratio (PER) and protein production ratio (PPR) in *Mugil cephalus* fed diets with or without garlic extract for 30 days.

Group	SGR (%)[a]	FCR[b]	CF (%)[c]	PER[d]	PPR(%)[f]
1	0.44± 0.49 [a]	0.09±0.01[a]	1.47±0.18[a]	24.44±12.82[a]	125.17±67.41[a]
2	1.29± 0.67[b]	0.08±0.03[a]	1.28±0.14[a]	27±3[b]	254.82±1.21[b]
3	1.83± 0.22[c]	0.08±0.01[a]	1.30±0.07[a]	32.76 ± 4.48[c]	359.11±55.51[c]
4	1.93±0.31[d]	0.08±0.02[a]	1.23±0.10[a]	35.12± 6.18[d]	415.05±67.58[d]

Within columns values with different superscripts are significantly different (p<0.05). a) specific growth rate (%)= (Ln final weight (g) – Ln initial weight (g)) ×100/ experiment days b) feed conversion ration = feed intake (g)/ wet weight gain (g) c) condition factor (%)= (fish weight (g) /fish length $(cm)^3$)×100 d) protein efficiency ratio = wet weight gain (g)/ protein intake f) protein production ratio (%)=[(final weight (g)×final body crude protein (%)- initial weight (g) × initial body crude)/ feed intake (g) × feed crud protein (%)] × 100. Group 1 (Control group) was fed with basal diet and the remaining groups (2-4) were fed with 0.5,1 and 3% concentrations of garlic extract in diets respectively. Values are Mean ± SE (n= 60).

Table 3: Proximate analysis expressed in percent dry weight of larvae carcass sampled of *Mugil cephalus* fed diets with or without garlic extract for 30 days[a].

Group	Moisture (%)	Protein (%)	Lipid (%)	Ash (%)
1	72.61± 0.11[d]	15.21± 0.04[a]	9.67±0.03[c]	2.63±0.19[a]
2	68.32± 0.03[C]	19.43±0.06[b]	7.71±0.08[b]	3.43±0.04[b]
3	66.84±0.08[b]	20.45±0.11[c]	3.57±0.57[a]	5.57±0.06[c]
4	62.35±0.17[a]	24.99±0.03[d]	3.37±0.01[a]	7.63±0.19[d]

a)At the beginning of the experiment, proximate analysis of grey mullet larvae carcass was as follows: crude protein 16.05 %± 0.30 SE, lipid 8.18± 0.95 SE, ash 9.43%± 0.31 SE and moisture 74.91 %± 0.38 SE. Within columns values with different superscripts are significantly different (p<0.05). Group 1 (Control group) was fed with basal diet and the remaining groups (2-4) were fed with 0.5,1 and 3% concentrations of garlic extract in diets respectively. Values are Mean ± SE (n= 9).

Similarly, Shalaby *et al.* (2006) also mentioned that the best performance was obtained in Nile tilapia fed a diet containing 30 g garlic powder per kilogram diet. In the same species, Ebrahim Dorche *et al.* (2013) found a positive improvement in final weight (153.43 g), body weight increase (516.58%), protein efficiency ratio (2.58) and protein production ratio

(48.38%) in *Husu huso* fed a diet containing garlic essential oil at the rate of 150 mg/ kg diet. A significant increase in weight gain and specific growth rate was recorded in *L. vannami* when fed *Artemia* nauplii enriched with 200mg garlic extract / L. (Javadzadeh *et al.*, 2012).

PER, PPR and FCR are utilized as quality indicators for fish diet and its amino acid balance. Therefore, these factors are used to evaluate protein utilization and turnover (Shalaby *et al.*, 2006). The present results are also in agreement with those obtained by Sahu *et al.* (2007) who found that FCR in fish (*Labeo rohita*) fed with 0.5, 1% garlic powder/kg diet was not significantly different as compared with those of the control. Also Khattab *et al.* (2004) reported that the biogenic diet increased feed intake, feed conversion ratio (FCR) and PER in fish. In contrast to these results, Nwabueze (2012) showed that garlic did not affect growth performance in *Clarias gariepinus*. Ndong and Fall (2007) reported that garlic supplemented diet resulted in decreased body weight gain in juvenile hybrid tilapia (*Oreochromis niloticus*×*O. aureus*) fed diets supplemented with 0.5g/kg garlic over 4 weeks. Reports on the effect of dietary garlic on growth performance are conflicting and may be related to inter-species differences, age, sex, feeding program, diet composition, level of garlic extract, its precursors in the diet and environmental conditions (Shalaby *et al.*, 2006).

In the present study, lipid and moisture in whole body composition of grey mullet larvae fed 0.5, 1 and 3% garlic extract in diet significantly (p<0.05) decreased compared to that in control diet. The lowest lipid (3.37±0.01%) and moisture (62.35±0.17%) was observed in fish fed 3% garlic extract in diet. Ash and protein content were significantly higher (p<0.05) in group 4 compared to those in groups 1-3. The fat-lowering effect of dietary garlic extract obtained in the present study may be explained, at least partly, by a reduction in hepatic lipogenic capacity, since the liver is the major site of lipogenesis in fish but other factors may also be responsible for the regulation of the rate of fat accumulation in adipose tissue. For example, increase in protein production ratio (PPR) in fish fed a garlic extract diet could increase the role of lipid as an energy source for growth, so deposition of lipid was lower in fish fed different concentrations of garlic extract in diet than that in the control. This may imply that abdominal fat is the most susceptible component in grey mullet carcass for alternation with garlic extract. This suggestion was supported by Shalaby *et al.* (2006) who reported that lowest lipid and highest protein were observed in fish (*A. ruthensis*) fed with 30 g garlic powder/kg diet. Conversely, another study on *Huso huso* showed that lipid, ash and moisture content were not affected by adding 150 mg garlic essential oil/ kg diet (Ebrahim Dorche *et al.*, 2013). Reports on the effect of dietary garlic

on whole body composition are conflicting and may be related to inter-species differences feeding program, diet composition, level of garlic extract, its precursors in the diet and environmental conditions (Ebrahim Dorche *et al.*, 2013).

This study has shown that 0.3% garlic extract in diet increased final length and weight, body weight increase, specific growth rate, protein efficiency ratio, and protein production ratio in larvae. Also the lowest fat and moisture levels and the highest protein and ash levels in body composition were observed in the fish fed the diet containing 3% garlic extract as compared to the rest of the treatment groups and the control. Therefore, garlic inclusion in fish diet at 3% concentration is beneficial for use in aquaculture to improve growth, feed performances and carcass quality of *M. cephalus* larvae.

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References

AOAC, 2000 . Official method of analysis of the association of official analytical chemists, 15th ed., Association of Official Analytical Chemists (AOAC), Arlington, VA, USA.

Citarasu, T., 2010. Herbal biomedicines: a new opportunity for aquaculture industry. *Aquaculture International,* 18(**3)**, 403-414.

Ebrahim Dorche, I., Tangestani, R., Alizadeh Dughyklayy, E. and Zare, P., 2013. Effect of different levels of garlic essential oil on growth, feed and carcass composition of beluga *(Huso huso*) rearing young. *Journal of Marine Science and Technology,* 11(**4**), 1-12.

Javadzadeh, M., Salarzadeh, A.R., Yahyavi, M., Hafezieh, M. and Darvishpour, H., 2012. Effect of garlic extract on growth and survival rate in *Litopenaeus vannami* post larval. *Iranian Scientific Fisheries Journal,* 21(**1**), 39-46.

Jayaprakas, V. and Sambhu, C., 1996. Growth response of white prawn, *Penaeus indicus* to dietary L-carnitine. *Asian Fisheries Society,* 9(**3**), 209-219.

Khalil, R.H., Nadia, B.M. and Soliman, M.K., 2001. Effects of Biogen and Levamisole HCl on the immune response of cultured *Oreochromis niloticus* to *Aeromonas hydrophila* vaccine. *Beni-Suef Veterinary Medicine Journal Egypt,* XI(**2**), 381-392.

Khattab, Y.A., Shalaby, A.M.S., Sharaf, S.M., EL-Marakby, H.I. and Rizhalla, E.H., 2004. The physiological changes and growth performance of the Nile tilapia *Oerochromis niloticus* after feeding

with Biogen as growth promoter. *Egypt Journal of Aquatic Biology and Fish*, 8(**2**)**,** 145-158.

Lee, D.H., Ra, C.S., Song, Y.H., Sung, K.I. and Kim, J.D., 2012. Effects of dietary garlic extract on growth, feed utilization and whole body composition of juvenile sterlet sturgeon (*Acipenser ruthenus*). *Asian-Australasian Journal of Animal Sciences*, 25 (**4**), 577-583.

Ndong, D. and Fall, J., 2007. The effect of garlic *(Allium sativum*) on growth and immune responses of hybrid tilapia (*Oreochromis niloticus*×*Oreochromis aureus*) *ASFA/Fisheries biology*, 5, 3-11.

Nwabueze, A.A., 2012. The effect of garlic (*Allium sativum)* on growth and haematological parameters of *Clarias gariepinus* (Burchell, 1822). *Sustainable Agriculture Research*, 1(**2**), 222-228.

Sahu, S., Das, B.K., Mishra, B.K., Pradhan, J. and Sarangi, N., 2007. Effect of *Allium sativum* on the immunity and survival of *Labeo rohita* infected with *Aeromonas hydrophila*. *Journal of Appled Ichthyology*, 23(**1**), 80-86.

Shalaby, A.M., Khattab, Y.M. and Abdel rahman, A.M., 2006. Effects of garlic (*Allium sativum*) and chloramphenicol on growth performance, physiological parameters and survival of Nile Tilapia (*Oreochromis niloticus*). *Journal of Venomous Animimals and Toxins Including Tropical Diseases*, 12(**2**), 172-201.

Yousefian, M., Ghanei, M., Pourgolam, R. and Rostami, H.K., 2009. Gonad evelopment and hormonal induction in artificial propagation of grey mullet, *Mugil Cephalus* L. *Research Journal of Fisheries and Hydrobiology*, 4(**2**), 35-40.