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Low cost fish feed for aquarium fish: a test case using *Colisa fasciata*

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Abstract

A comprehensive trial was undertaken to assess the effect of various types of feed on biomass conversion rate as well as on gonad (ovarian) weight in *Colisa fasciata*, a dual-purpose fish for food and ornamental use. Three groups of juvenile fish (3.0 ± 0.015 g; 10.00 ± 0.75 mm) were fed with three different types of feed: dried earthworm feed, laboratory prepared feed (LPF) and market feed. The LPF made with dried earthworm powder, eggshell powder and plant rhizome (*Commelina* sp.) dusts proved to be the best and economical feed among the three feed tested. The LPF also increased gonad weight of the cultured fishes indicating a production of more fish offspring's from a single female fish. The plant rhizome possibly played a role in increasingly appetite among LPF cultured fish, which in turn influenced somatic as well as reproductive growth of those fish.

Additional key words: *Colisa fasciata*, dual purpose feed, fish feed, gonad weight, growth.

Resumen

Pescado como pienso a bajo coste para peces de acuario: *Colisa fasciata* como caso de prueba

Se llevó a cabo un ensayo para evaluar el efecto de distintos tipos de pienso en la tasa de conversión de biomasa, así como en el peso de las gónadas (ovarios) de *Colisa fasciata*, pescado tanto con uso ornamental como para alimentación. Se sometieron tres grupos de ejemplares juveniles (3,0 ± 0,015 g, 10,00 ± 0,75 mm) a tres tipos diferentes de alimentación: lombrices de tierra desecadas, pienso preparado en el laboratorio (LPF), y pienso comercial. El LPF preparado con polvo de lombriz de tierra desecada, polvo de cáscara de huevo y rizoma de plantas (*Commelina* sp.) resultó ser el alimento mejor y más económico entre los tres analizados. El LPF también aumentó el peso de las gónadas de los peces cultivados, lo que implica una mayor producción de crías. El rizoma de plantas posiblemente aumentó de forma progresiva el apetito de los peces cultivados con LPF, lo que a su vez influyó en el crecimiento somático y reproductivo de los peces.

Palabras clave adicionales: alimento con doble finalidad, *Colisa fasciata,* crecimiento de peces, peso de gónada, pienso de pescado.

Introduction

The high cost coupled with short supply of desired quality fish meal has made it necessary to substitute it with other cheaper feed which can be prepared by the farmer easily in expense of less money and labour. Since the quality of the fish meal available in the third world countries is generally very poor, adulterated and infested with microbial contamination, alternative feed need to be researched out for proper somatic as well as reproductive growth in fish. The growth of fish is directly dependent on feed composition, quality and quantity (Sampath and Pandian, 1984; James *et al.*, 1993; Jobling, 1998) and various types of dry feed formulations have been tried as substitutes for natural food for both edible and ornamental fishes (Khan and

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Abbreviations used: DEF (dried earthworm feed), GSI (gonado-somatic index), LPF (laboratory prepared feed), MF (market feed).

Jafri, 1990; Lochmann and Phillips, 1994; James and Sampath, 2002). Many authors have studied the effects of nutrition on the growth of edible fishes (Degani *et al.,* 1985; Wah Lam and Shephard, 1988; Khan and Jafri, 1990; Kim *et al.,* 1996) as well as on growth and reproduction in ornamental fish (*e.g.,* Degani, 1991; Degani and Gur, 1992; Degani and Yehuda, 1996; James and Sampath, 2004). However, production of food fish is a time-consuming exercise and the fish produced have less value when compared with any ornamental fish in cost benefit analysis. The gourami, *Colisa fasciata*, is an important fish with respect to its value as food as well as for ornamental use (Goodwin, 2003). The fish was selected as it shows somatic as well as reproductive growth under laboratory conditions. The species is also easy to feed on live, frozen and flake feeds (Goodwin, 2003). A low cost feed is necessary for successful ornamental fish production. It should be possible to prepare the feed on farm very easily and inexpensively by untrained fish farmers. The present work was undertaken to study the effects of feed quality on growth, gonad development and fertility in *C. fasciata*, a dual purpose fish for human foods as well as ornamental use in aquaria.

Material and methods

Diets

Diet 1, the dried earthworm feed (DEF), was prepared from earthworms that were collected and placed in water for complete evacuation of their guts. Those worms were then chopped, dried and ground to a powder, which was then mixed with wheat flour (dried earthworm 65% + wheat flour 35%).

Diet 2, the laboratory prepared feed (LPF), consisted of poultry eggshell powder (30%), dried earthworm powder (55%), plant rhizome powder (*Commelina* sp., 5%) and wheat flour (10%). The eggshells were collected from various fast food centers at no cost. The shells contained 5% egg albumin (on average by weight) which provided additional high quality protein in the feed. The plant rhizome powder is a fish attractant that is used by tribal people as fish baits.

Diet 3, the market feed (MF) was a commercial feed that is commonly available in ornamental fish shops. The test preparation was made from albumin (10%), beef extracts (30%), rice flour (40%) and white flour (20%). The brand name of the feed is not disclosed for legal reasons. The cost of that feed can be as much as 20 times more than the other two test feeds.

Experimental set up

Ninety 30-day-old juvenile *C. fasciata* (16.00 ± 0.75 mm; 3.0 ± 0.15 g) were collected from a local fish market. They were sorted into three groups of 30 individuals, so that at least eight probable female fish were associated with each group. The three groups were each divided into three subgroups of 10 that were stocked in nine plastic tubs containing 20-L of water. This provided three treatment groups that were placed on the experimental feeds. The water system was static in nature. The experiment was conducted for 150 days.

The chlorine-free well water (temperature 30 ± 4°C, pH 7.2 ± 0.05, hardness 140 ± 15 mg L^{-1}, ammonia 0.81 ± 0.12 mg L^{-1} and dissolved oxygen 4 mg L^{-1}) was monitored biweekly. The tanks were drained twice a week and refilled with new water to remove accumulated feces.

Feeding

The feed was given in a feeding bag hung from an iron rod at 09:00 am for 2 h in four locations in each tank. Unconsumed feed was removed and dried in a hot air over at 100°C. Feed consumption was estimated by subtracting the weight of the unconsumed feed from the weight of the feed offered. The feeding rate was calculated as the amount of feed consumed (mg) × initial wet weight of fish $(g)^{-1}$ × number of $days^{-1}$. Fish, feed samples, and unconsumed feeds were weighed on an electric balance to an accuracy of 0.1 mg.

Growth calculation

Before the commencement of the experiment, each fish was weighed. Three fish from the stock were sacrificed to calculate their initial water content (Maynard and Loosli, 1962) and dry weight. The fish in each tank were collected and weighed after one month and the dry weight was calculated by using the percent water content of the fish sacrificed at the beginning of the experiment. Growth was calculated by subtracting the initial weight from the final weight. The growth rate of fish was calculated as [final weight (in mg) – initial wet weight (in mg)] / number of days.

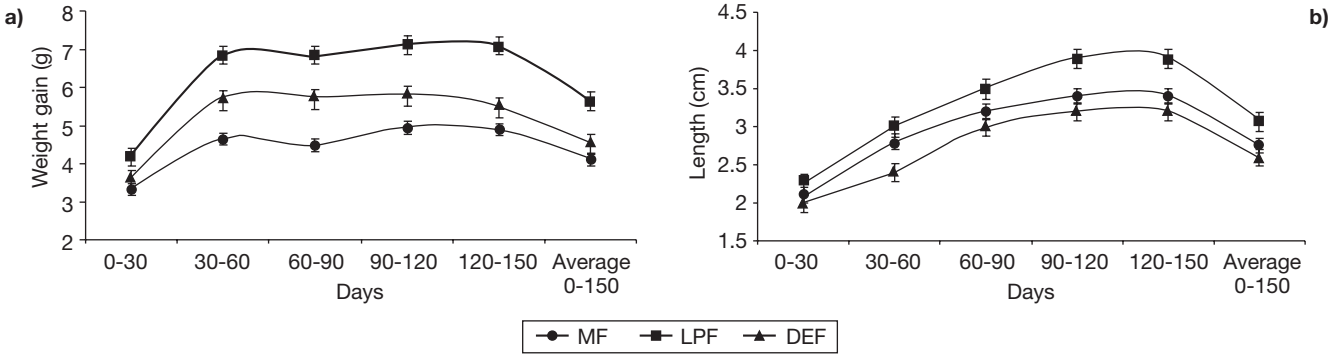

Figure 1. Changes in a) weight and b) length of *Colisa fasciata* in various treatments. MF: market feed. LPF: laboratory prepared feed. DEF: dried earthworm feed.

Gonad estimation

Gonad weight was measured at day 60 (development of gonad marked on day 55) to day 150. Females from each treatment were sacrificed to study the appearance of ovary. The ovaries were first removed weighted and then gonado-somatic index (GSI) was computed according to the formula of Dahlgren (1979): GSI (in %) = wet weight of gonad (mg) × wet weight of the fish $(mg)^{-1} \times 100$.

Feed analysis

The protein and lipid contents of the experimental diets were determined in a spectrophotometer following Lowry *et al.* (1951) and Bragdon (1951) respectively. Moisture content was analyzed by drying the feed in an electric hot air oven at 100ºC.

Statistical analysis

Student's t test was used to determine the significance of differences in mean gonad weight and remaining period among experimental groups. One-way ANOVA was used to find the significant effects of feed type and rearing period on the feed and growth rates and also to test the significance of feed type on production of young (Zar, 1974).

Table 1. Proximate composition (%) of experimental diets

Food analysis	MF[1]	LPF[2]	DEF[3]
Protein	38.5	38.8	38.7
Crude fat	4.5	5.4	5.9

[1] MF: market feed. [2] LPF: laboratory prepared feed. [3] DEF: dried earthworm feed.

Results

Protein content was similar used in the three tested feeds (MF, LPF and DEF) (Table 1). The fish group fed with LPF showed the highest growth (7.10 g) followed by DEF fed (5.82 g) and MF fed (4.94 g) fishes (Fig. 1a). The fish fed with LPF had the highest value in average feeding rate (0.04176 g $days^{-1}$), followed by DEF (0.0316 g $days^{-1}$) and MF (0.0228 g $days^{-1}$) (Fig. 2). Differences during the early rearing period (day 0-day 60) were highly significant (ANOVA $P < 0.05$) among three feed brands in feeding rates as well as in conversion rate (Fig. 3). But the rates dropped at the commencement of breeding period. The length and weight gained by the fish fed with MF was the lowest

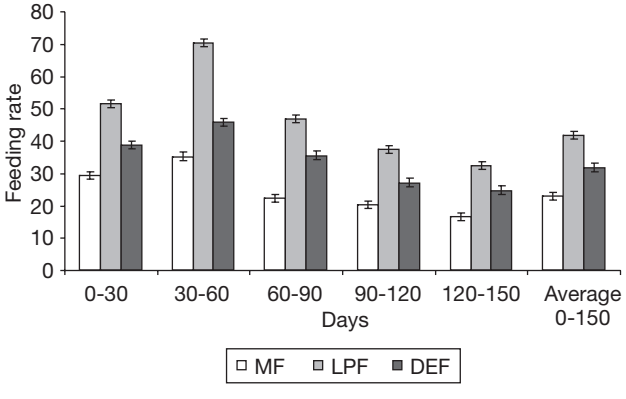

Figure 2. Feeding rate of *Colisia fasciata* in various treatments. MF: market feed. LPF: laboratory prepared feed. DEF: dried earthworm feed.

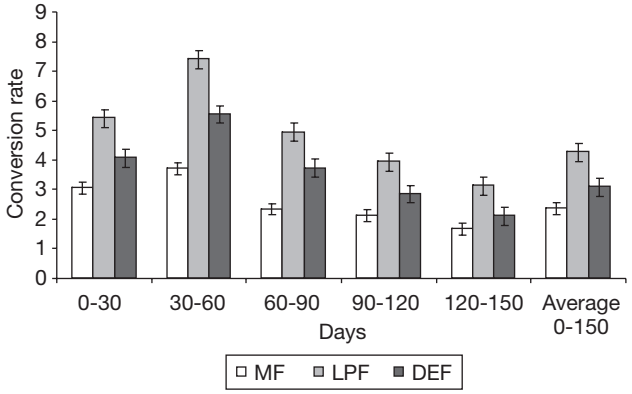

Figure 3. Conversion rates of *Colisia fasciata* in various treatments. MF: market feed. LPF: laboratory prepared feed. DEF: dried earthworm feed.

(4.11 g, 2.6 cm), followed by DEF (4.56 g, 2.75 cm) and was highest in LPF (5.62 g, 3.0 cm) (Fig. 1a and 1b). The length and weight gained by the fish fed with DEF and MF did not differ statistically, but there was a significant difference in length and weight ($P < 0.05$) among the fish fed with LPF, DEF and MF (Fig. 1a and 1b).

Feed type varied significantly ($P < 0.05$) in respect to increase in gonad weight and GSI. Irrespective of feed type, the development of gonad started on day 55 and then gradually increased in weight until spawning. There was a distinct positive correlation between gonad weight and rearing period ($P < 0.05$) up to day 120 (Fig. 4a). Feed type significantly ($P < 0.001$) influenced the gonad weight and somatic growth. However, the value of GSI was not significantly different among treatments.

Gonado-somatic index was similar as expected but significant difference ($P > 0.001$) (Fig. 4a) was observed among the treatments in relation to gonad weight. The highest gonad weight of 190 mg was recorded in the fish fed with LPF.

Discussion

In the present trial LPF promoted high food consumption and growth in the experimental fish in this trial. Perhaps the plant rhizome (*Commelina* sp.) dust has played a role in increasing the appetite of the fish. LPF was a mixed feed which contains albumin, calcium (from egg shell) earthworm body protein, iron, carbohydrate as well as some micronutrients from the rhizome dust. These ingredients played as growth promoter. The protein (38%) and iron component of LPF promoted growth significantly, when compared with other test feeds. Nandeesha *et al.* (1994) also reported that mixed diet treatments were superior to single high protein diet because nitrogen retention was higher in the fish fed with mixed treatment. The poor growth rate observed in fish fed with pelleted feed suggests that pellets are not suitable to juvenile *Colisa fasciata*. This was in agreement with Degani (1991) that juvenile *Trichgaster trichopterus* fed live food grew faster than that fed formulated feed because of the palatability, high consumption, and chemical composition of the live food.

The growth rate dropped just before and during the breeding periods. The reproductive cycle of *C. fasciata* fish is short. Female *C. fasciata* allocates a major por-

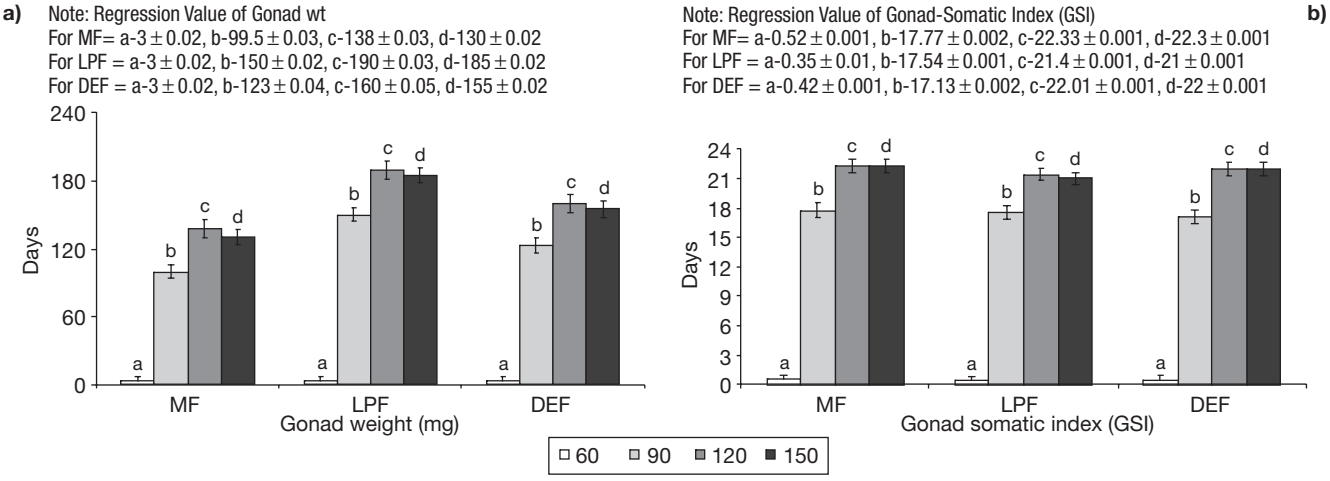

Figure 4. Changes of a) gonad weight (mg) and b) gonad-somatic index (GSI, %) in *Colisa fasciata* among various treatments. MF: market feed. LPF: laboratory prepared feed. DEF: dried earthworm feed.

tion of assimilated energy to gonad development and a small fraction of energy could be spared for growth during and just prior to breeding. Cessation of somatic growth with gonad development was observed in salmonids (Hardy, 1983; Washburn *et al.*, 1990) and it has been suggested that this is the result of hormonal changes during the later phase of gametogenesis. Fish fed pelleted feed had poorer fertility than the other groups. This may be due to a deficiency of nutrients in feed essential for reproductive development though its preference (feeding rate) was high among the fish. Based on the present study, it can be concluded that feed type significantly ($P < 0.001$) influences the gonad and somatic growth and the brand feeds like LPF, DEF and MF were the most suitable for increasing fertility and somatic growth in *C. fasciata,* which serves an important dual purpose as human food and ornamental use in aquaria.

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References

BRAGDON J.H., 1951. Colorimetric determination of blood lipids. J Biol Chem 190, 513-517.

DAHLGREN B.T., 1979. Effects of population density on fecundity and fertility in the guppy, *Poecilia reticulata* (Peters). J Fish Biol 15, 71-91.

DEGANI G., 1991. The effect of diet population density and temperature on growth of larval and juveniles *Trichogaster trichopterus* (Bloch and Schneider, 1901). J Aqua Trop 6, 135-141.

DEGANI G., GUR N., 1992. Growth of juvenile *Trichogaster leerii* (Bleeker, 1852) on diets with various protein levels. Aquacultult Fish Manag 23, 161-166.

DEGANI G., YEHUDA Y., 1996. Effects of diets on reproduction of angel fish *Pterophyllum scalare* (Cichlidae). Indian J Fish 43, 121-126.

DEGANI G., HOROWITZ A., LEVANON D., 1985. Effect of protein level in purified diet and of density, ammonia and O_2 level on growth of juvenile European eels *Anguilla anguilla* (L). Aquaculture 46, 193-200.

GOODWIN D., 2003. The practical aquarium fish handbook. Sterling Publ Co. 256 pp.

HARDY R.W., 1983. Salmonid broodstock nutrition. In: Salmonid reproduction. An International Symposium (Iwamoto R., Sower S., eds). Bellevue, WA, USA. pp. 98-108.

JAMES R., SAMPATH K., 2002. Effect of different feeds on growth and fecundity in ornamental fish, *Betta splendens* (Regan). Indian J Fish 49(3), 279-285.

JAMES R., SAMPATH K., 2004. Effect of feeding frequency on growth and fecundity in an ornamental fish, *Betta splendens* (Regan). Isr J Aquacult- Bamid 56(2), 138-147.

JAMES R., MUTHUKRISHNAN J., SAMPATH K., 1993. Effect of food quality on temporal and energetics cost of feeding in *Cyprinus carpio* (Cyprinidae). J Aqua Trop 8, 47-53.

JOBLING M., 1998. Feeding and nutrition in intensive fish farming. In: Biology of farmed fish (Black K.D., Pickering A.D., eds). Sheffield Academic Press, Sheffield, UK. pp. 67-113.

KHAN M.A., JAFRI A.K., 1990. On the dietary protein requirement of *Clarias batrachus* Linnaeus. J Aquacult Tropics 5, 191-198.

KIM J., MASSES K.C., HARDY R.W., 1996. Adult *Artemia* as food for first feeding coho salmon (*Oncorhynchus Kisutch*). Aquaculture 144, 217-226.

LOCHMANN R.J., PHILLIPS H., 1994. Dietary protein reqruirement of juvenile golden shinners (*Notemigonus crysoleucas*) and goldfish (*Carassius auratus*) in aquaria. Aquaculture 128, 277-285.

LOWRY O.H., ROSEBROUGH N.J., FARR A.L., RANDALL R.J., 1951. Protein measurements with Folin-phenol reagent. J Biol Chem 193, 265-275.

MAYNARD A.L., LOOSLI K.S., 1962. Animal nutrition. McGraw Hill, NY. 533 pp.

NANDEESHA M.C., DE SILVA S.S., KRISHNAMURTHY D., DATHATRI K., 1994. Use of mixed feeding schedules in fish culture: field trials on *Catla catla* (Hamilton-Buchanan) rohu *Labeo rohita* (Hamilton) and common carp, *Cyprinus carpio*. Aquacult Fish Manag 25, 659-670.

SAMPATH K., PANDIAN T.J., 1984. Interaction of feeding frequency and density on feed utilization in air-breathing murrel, *Channa striatus*. Proc Indian Acad Sci 93, 445-453.

WAH LAM S., SHEPHARD K.L., 1988. Some effects of natural food levels and high protein supplement on the growth of carp. Aquaculture 72, 131-138.

WASHBURN B.S., FRYE D.J., HUNG S.S.O., DOROSHOV F.S., CONTE F.S., 1990. Dietary effects on tissue composition, oogenesis and the reproductive performance of female rainbow trout (*Oncorhynchus mykiss*). Aquaculture 90, 179-195.

ZAR J.H., 1974. Biostatistical analysis. Prentice-Hall Inc, Englewood Cliffs, NJ. pp. 101-162.