Is dried Spirulina suitable as a sole source of feed for the feeding onset of the estuarine tilapia *Sarotherodon melanotheron heudelotii* ?

Frederic Clota [1&3], Beatrice Chatain [2], Paul Lozano [3]

1. INRA - Unit 0558 Dept. PHASE, Nouzilly, France
2. Ifremer - UMR 9190 MARBEC, Palavas-les-Flots, France
3. Cirad - UMR 116 ISEM, Montpellier, France

aquaculture 2015 — 23-26 August 2015 Montpellier, France

INTRODUCTION

Faced the rapid world-wide expansion of aquaculture and the rarefaction of natural resources, to find alternatives to fishmeal and oil issued from wild for fish feed, became a real challenge.
Microalgae are often pointed out as good candidates specially as substitute to fishmeal, and among them, spirulina (*Arthrospira platensis*), a cyanobacterium, which is characterized by a high protein content and digestibility, and lacks anti-nutritional factor[1]. These algae are also relatively easy to produce, industrially or handmade by fish farmers themselves, especially in tropical countries[2].

In this experiment, we have chosen to test this spirulina as a sole source of feed for the *Sarotherodon melanotheron heudelotii*. This species is an euryhaline tilapia, which grow correctly in all types of salinity[3], and is therefore pointed to match another important challenge, *i.e.*, the global change responsible of the rapid raising of salinity in tropical countries. Previous studies showed that juveniles and adults of *S. melanotheron* could be only fed with dried spirulina without deleterious effect, though growth was lower than commercial feed[4], and that Nile tilapia (*O. niloticus*) larvae accepted fresh raw spirulina from the onset of feeding[5].
Our aim here, was to experiment if the *S. melanotheron* larvae could be fed with only dried spirulina from the onset of feeding and to 40 day-old post fertilization (DPF).

MATERIALS & METHODS

Spirulina diet (S group)
Algae were produced in PBR[6], harvested by membrane technology[6], shaped into spaghetti, and dried at 65°C during 24 hours.

Control diet (C group)
The commercial pellet was Biomar INICIO plus-Tilapia.
All pellets were manually grinded then sieved to obtain two ranges of size : ≤0.16 mm & 0.16<ø≤0.6mm.

Biological material and rearing design
336 larvae were obtained from natural spawning, and distributed in 6 aquarium (32 litres each; 52 larvae per tank; 1 triplicate per feed).

Fresh water was supplied in recirculating system, temperature maintained at 28.6 °C, dissolved oxygen at 6.26ppt, pH at 8. Photoperiod was 12D:12N, and light intensity 230 lux.

Feeding strategy
Feeding started at 10 DPF (larvae mean weight = 16±0,2 mg)
Feed was manually distributed 4 times a day (twice during week-ends).

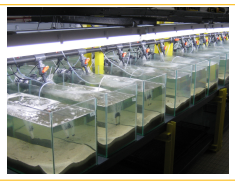
C groups received the same amount than S ones calculated on an individual base taking account fish biomass and survival.

Measures
All individuals were weighted at the age of 17, 24, 32 and 40 day-old. They were also length at day 40.

Then triplicates were pooled and reared two months more, where proximate composition was operated on a sample of 55 g of fish fed on each diet.








RESULTS AND DISCUSSION

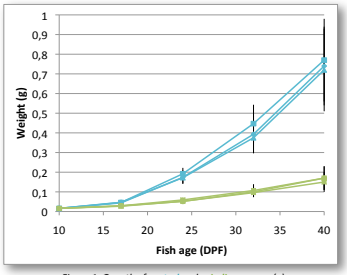


Figure 1. Growth of control and spirulina groups (g)

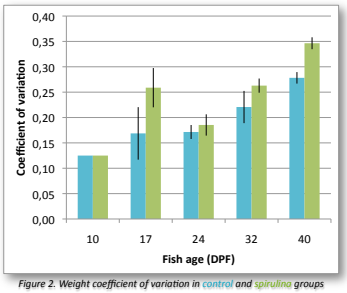


Figure 2. Weight coefficient of variation in control and spirulina groups

All fish have accepted the dry spirulina pellets from the onset of feeding, and at the end of the experiment (40 DPF), the following features were observed:

- Survival rates were similar in both treatments (92%)
- No body deformity was observed in any groups
- The mean weight of fry fed with spirulina was almost 5 times smaller than that of controls (0.16±0,06 *versus* 0.74±0,21 g; Fig. 1) with a mean coefficient of variation slightly higher (from 35±0,01 *versus* 28±0,01 %; Fig. 2). Their condition index (Weight / Length^3) was also lower than controls (1,5±0,2 *versus* 1,7±0,1).
- The proximate composition analysis revealed that the spirulina fed fry have a global energy content 11% lower (512 *versus* 573 KJ/100 g of dry matter), a moisture content 6% lower (68,2 *versus* 72,6%), and the following differences (Fig. 3):
  - Ash: -13%
  - Lipids: +7%
  - Proteins: +37%
  - Carbohydrates: -88%
- The fatty acids (FA) analysis showed that (Fig. 4):
  - Among the unsaturated FA, monounsaturated one's were dominant, and mainly represented by ω-9 in both type of fry
  - Among the polyunsaturated FA, the ratio ω-3/ ω-6 was drastically depressed in the spirulina fed fry (2,6 *versus* 0,1)

This preliminary study suggests that it is possible to use dried spirulina to start feed estuarine tilapia larvae, and to rear them in the early stage without effects on mortality and deformities but with a major negative impact on growth compared to the performances obtained with a standard diet. Body composition shows higher amount of saturated fatty acids and lower amount of ω-3 polyunsaturated fatty acids probably reflecting the presence of fish oil in the standard diet. It would be interesting to in further investigations to investigate if a shift of the diet (from spirulina to commercial diet after a few days of use) would correct these defects.

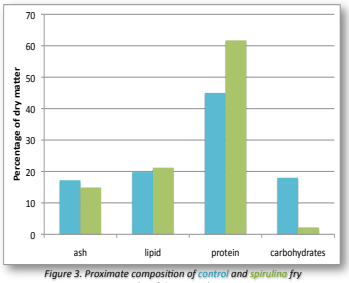


Figure 3. Proximate composition of control and spirulina fry (% of dry matter)

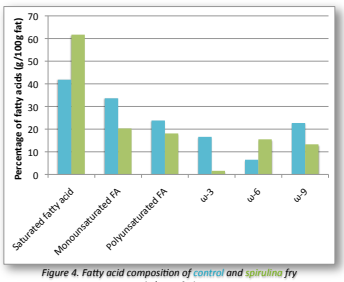


Figure 4. Fatty acid composition of control and spirulina fry (g/100g fat)

REFERENCES

1. Sarker P.K., Gamble M.M., Kelson S., and A.R. Kapuscinski, 2015. Nile tilapia (*Oreochromis niloticus*) show high digestibility of lipid and fatty acids from marine *Schizochytrium sp.* and of protein and essential amino acids from freshwater *Spirulina sp.* feed ingredients. *Aquaculture Nutrition* 2015: 1-11
2. Habib M.A.B., Parvin M., Huntington T.C., and M.R. Hasan, 2008. A review on culture, production and use of spirulina as food for humans and feeds for domestic animals and fish. *FAO Fisheries and Aquaculture Circular* No. 1034, Rome, 33p
3. Lemarié G., Baroiller J.F., Clota F., Lazard J., and A. Dosdat, 2004. A simple test to estimate the salinity resistance of fish with specific application to *O. niloticus* and *S. melanotheron*. *Aquaculture* 240: 575-587
4. Clota F., Lozano Y., P., Lozano, 2012. Unpublished data
5. Lu J., Yoshizaki G., Sakai K., and T. Takeuchi, 2002. Acceptability of raw *Spirulina platensis* by larval tilapia *Oreochromis niloticus*. Fisheries Science: 68: 51-58
6. Bamba B.S.B., Yu X., Lozano P., Ouattara A., Abert-Vian M., Y. Lozano, 2014. Photobioreactor-based procedures for reproducible small-scale production of microalgal biomasses. *Journal of Algal Biomass Utilization* 5 (1): 1-14