ORGANIC TILAPIA CULTURE IN ISRAEL

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Introduction

The market for organic products is one of the fastest growing segments in consumer packaged goods. People demand and consume organic products because they believe that these products are safer and healthier for both human beings and the environment. This public pressure created a world organic retail market that increased from US dollars 10 billion in 1997 to US dollars 17.5 billion in 2000, has an estimated growth rate of about 18 % per year (world average), and sales could reach up to 70-80 billion US dollars in the year 2008 (ITC, 2002).

Organic aquaculture is new and production is mainly of cold-water salmonids in Europe and Northern USA. Warm-water organic aquaculture is even newer, and is limited to a few fish ponds in Israel and some shrimp ponds in Ecuador and Peru. In Israel, organic aquaculture started at kibbutz Geva fish farm in 2000 with blue tilapia (*Oreochromis aureus*) as main species of the polyculture. At present this is the first and only farm in the world that obtained organic certification for tilapia.

Fish growers practicing organic farming have little practical experience dealing with the restrictions of organic production. R&D on organic aquaculture is almost inexistent. IFOAM (International Federation of Organic Agriculture Movements) organic standards impose numerous conditions and restrictions, favoring production techniques that respect the physiological and ethological needs of the organisms and are directed at their good health and welfare. The basis for organic aquaculture production is the maintenance of the aquatic environment and surrounding aquatic and terrestrial ecosystem, achieved by encouraging the use of by-products and waste materials as a feed source, enhancing biological cycles in production, prohibiting synthetic fertilizers, avoiding chemotherapeutic agents, reducing environmental impact of effluents and wastes, and promoting polyculture when applicable.

Commercial organic tilapia production

The first organic pond of Geva fishfarm is 3.5 ha and 1.5 m maximum depth. In 2000 the pond was stocked with 12,000 fish/ha of which 10,000 were the omnivorous blue tilapia (*Oreochromis aureus*). The other species stocked included small numbers of the illiophagous mullet (*Mugil cephalus*), the bottom feeder common carp (*Cyprinus carpio*), the mollusk eater black carp (*Mylopharyngodon piceus*), the grass eater grass carp

(*Ctenopharyngodon idella*), the phytoplankton filter feeder silver carp (*Hypophthalmychthys molitrix*) and the predator red drum (*Sciaenops ocellatus*) that was stocked to control wild spawning of tilapia and common carp.

The pond was managed following organic rules. Since fish were not sex-reversed, large amounts of wild spawning of tilapia and common carp occurred. Supplied feeds had 14% protein, and contained 4.9% fishmeal and 95% organic wheat. The pond was harvested during the winter 2000-2001. It produced 12 t of fish, of which 5 t of tilapia and 2 t of mullet were sold in the organic market, 3 t of wild tilapia and common carp were discarded, and the remaining fish were re-stocked in the organic pond for the next culture season. From the economic point of view, this first experience resulted in no money lost and no money earned.

From 2000 to 2003 stocking density in the organic pond varied from 11,000 to 14,000 fish/ha, of which 80-90% were tilapia, 5% red drum, and the remaining fish were small numbers of the Chinese carps indicated above that were harvested each year and re-stocked in the pond for the next culture season. Mullets were about 10% of the fish stocked the first two years, but since their survival was under 50% due to the high temperature that this shallow pond reaches in summer (over 30°C), mullet stocking was discontinued thereafter. In 2001 the pond was stocked with tilapias that were obtained crossing genetic lines that resulted in a higher male proportion, thus reducing the wild spawning problem (from 3 t in 2000 to 1 t in 2002). The amount of tilapia from this pond sold in the organic market increased from 5 t for the fish stocked in 2000 to 7 t for those stocked in 2002. The fish stocked in 2003 still were not completely harvested; until Feb-04 2 t were already marketed, and at least another 10 t are expected to be harvested and commercialized as organic product in the next few months. The farm is now extending its organic pond area. Four ponds of 3.5 ha each already have organic certification, another 20 ha of ponds will get certified in a couple of months, and all will be stocked in spring 2004.

Periphyton-based organic tilapia production trial

Besides the commercial production, in 2003 a trial to improve natural food production for tilapia and reduce added feed costs was carried out. One of the main difficulties of organic aquaculture is that feeds must have at least 95% of organic components. This forbids or strongly limits the use of the two main sources of protein used in conventional aquaculture feeds (soy and fish meals), and doubles the cost of feeds produced organic. On the other hand, organic standards encourage the use of feed sources of biological origin not suitable for human consumption. One way to increase natural productivity of water bodies that fits the organic production philosophy are periphyton-based systems. In those systems hard surfaces are introduced in the water column to allow the establishment of sessile autotrophic and heterotrophic populations, increasing natural productivity of the water body and serving as food for the cultured organisms. Such systems made of bamboo poles or tree branches have long been practiced in Africa (e.g. "acadjas" in West African coastal lagoons, Hem and Avit 1994) and Asia (e.g. "katha" fishery in Bangladesh, Wahab and Kibria 1994). Natural and artificial periphyton-based systems, periphyton productivity, and the potential of fish production based on periphyton have been recently reviewed by van Dam *et al*. (2002). The mutual effects among periphyton,

phytoplankton, water quality, different cultured fish species and management procedures in periphyton-based earthen fishponds in Bangladesh were studied by Azim *et al*. (2003) and Milstein *et al.* (2003). Under Israeli conditions, periphyton-based aquaculture was tried in an organic tilapia pond using discarded irrigation pipes as submerged hard substrates for periphyton growth.

The test was performed in a small (500 m^2) pond divided by a plastic rigid net. In one side of the pond 900 m^2 of submerged hard substrates were introduced to induce periphyton development on their surface and no feeds were supplied to the fish. Floating feed pellets were supplied only in the side without substrates, when the wind was not blowing towards the periphyton side. In each half pond 258 tilapia of 250g were stocked. After four months, tilapia feeding on natural periphyton and on supplied feed pellets showed the same harvesting weight, yield, survival and growth rate (Table 1). This points to periphyton-based aquaculture as an appropriate technology to reduce costs and allow an economically viable organic tilapia production. In 2004 this technology will be tested in the 3.5 ha ponds for commercial organic tilapia production.

Table 1. Tilapia harvesting data per half pond (250 m^2).

	Periphyton side	Feed side
Tilapia number	248	236
Biomass (kg)	110.5	107.4
Mean weight (g)	446	455
Survival (%)	96	91
Growth rate (g/day)	1.61	1.68
Yield (kg in 122 days)	48.5	48.4
Wild spawning (kg)	13	10
Feed (kg)		800
Manure (kg)	90	

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