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Effect of Canola Oil and of Beef Fat Coated Commercial Extruded Diets on Growth Performance of Red Hybrid Tilapia (Mutant Pink Nile Tilapia *Oreochromis niloticus* ♂ X Wild Blue Tilapia *O. aureus* ♀) Juveniles

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ABSTRACT A 45 day feeding trial was conducted to evaluate the effect of canola oil and of beef fat coated commercial extruded diet on the growth performance of red hybrid tilapia (mutant pink Nile tilapia *Oreochromis niloticus* ♂ X wild blue tilapia *O. aureus* ♀) juveniles. The red hybrid tilapia with initial weight ranges between 2.4 and 3.4 g were reared in a fresh water re-circulation system (water flow: 0.5 L/min) at 30° C and 0.2 – 0.4 ppt temperature and salinity respectively. The extruded diet that was coated with three different concentrations *viz.*, 5%, 10% and 20% of canola oil and of beef fat. The canola oil and beef fat coated diets were given *ad libitum* to red hybrid tilapia at 09.00, 13.00 and 17.00 h daily. The control diet was not sprayed with any lipid sources. All the treatments showed better survival (100%). The best specific growth rate ($P < 0.05$) and feed conversion ratio were observed in the 5% canola oil coated diet. When comparing the canola oil and beef fat coated diets, canola oil coated diets performed better than the beef fat coated diets on fish.

(Canola oil, beef fat, dietary enrichment, red hybrid tilapia)

INTRODUCTION

Dietary lipid is recognized as an energy source that would seemingly be more crucial to achieving satisfactory growth of fish. It is assumed that the quantity and quality of carbohydrates produced by the fish would be limited based upon the known composition of the feed [1]. Lipid in the form of cholesterol, phospholipids and essential fatty acids has been found to be important for the nutritional physiology of fish and crustaceans [2 and 3]. Perhaps a threshold dietary level is necessary for fish to attain the desired amount in the tissue for normal growth, development and survival [4 and 5]. According to Martins et al. [6] the development of adequate diets is important as feed represents the single largest operational expense of fish farming, with the lipid component accounting for as much as 25% of the dietary costs.

Du et al. [7] reported that fish utilize protein preferentially to lipid and/or carbohydrate as an energy source, but lipid also plays an important role in fish diets. Within certain limits, increasing dietary lipid levels improve diet utilization [8, 9 and 10]. Dietary lipid was also reported to bring protein sparing effect, replacing protein, which may otherwise be used to provide energy [11 and 12] to reduce organic matter and nitrogen losses [13]. The dietary lipid levels must be evaluated carefully in fish species because it may lead to increased fat deposition in flesh. Some authors reported that lipid have no protein sparing effect in some fish species [14 and 15]. The present study was attempted to evaluate the effect of canola oil and of beef fat coated commercial extruded diet on the growth performance of red hybrid tilapia (mutant pink Nile tilapia *Oreochromis niloticus* ♂ X wild blue tilapia *O. aureus* ♀) juveniles.

MATERIALS AND METHODS

Rearing system

Twenty one rectangular plastic containers (each of a capacity 10 L) were used in the present study. The tanks were grouped into 7 separate systems. Each system consisted of three rearing tanks connected to a separate water-cleaning unit. The water-cleaning unit consisted of a 100-L tank filled with volcanic gravel and strongly aerated water acting as a biological filter. Water from the cleaning unit was re-circulated into each rearing tank at the rate of 0.5 liter/ minute. Twenty liters of water were renewed daily in each system. Continuous aeration was provided by a blower and diffused air stone in each of the rearing tanks allowing oxygen levels of > 4 ppm. The water temperature was maintained at 28 ± 1 °C using thermostatically controlled glass heaters (Jagers, Germany). Every morning, before first feeding (09.00 h), water salinity (‰), temperature (°C) and water flow (L/min) were recorded.

Fish stocking

Red hybrid tilapia juveniles of an initial body weight ranging from 2.4 to 3.4g were collected from the total stock at The Bengis Centre for Desert Aquaculture, Ben-Gurion University of the Negev, Israel and 15 fish were distributed randomly into each tank. The fish weight was recorded at 10 day intervals throughout the experiment to determine their growth rate.

Experimental diets

The commercial extruded diet marketed by Zemach Feed Mills, Israel (Feed No. 4622) was used as a control diet in the present experiment. The approximate composition of the extruded diet is moisture 10%, protein 35%, lipid 4%, ash 7% and fiber 6%. The non-oil coated control diet was additionally sprayed with 3 different concentrations of canola oil and 3 different concentrations of beef fat *viz.,* I: 5%, II: 10% and III: 20%. The fish were fed 3 times daily at 09.00h, 13.00h and 17.00h to apparent satiation. The feeding study was conducted for 45 days.

Observation and measurements

Regular measurement of water salinity, temperature and water flow was measured and recorded. Growth, survival, and feeding rate were calculated as follows:

Survival (%) = [(no. of fish stocked - no. of mortalities)/ no. of fish stocked] x 100;

Total weight gain (g) = total final weight – total initial weight;

Average weight gain (%) = [(final average weight – initial average weight)/ initial average weight] x 100;

Specific growth rate (SGR; $\%d^{-1}$) = [(log e final average weight – log e initial average weight)/ total duration of the experiment] x 100;

Feed conversion ratio (FCR) = dry weight of feed intake (g) / wet weight gain (g).

Statistics

The growth data were subjected to mean, standard deviation, one-way ANOVA and Tukey's Multiple Range Test [16].

RESULTS

Water quality

Water salinity and water flow was 0.47 ± 0.12 ppt and 0.5 ± 0 L/min respectively, throughout the experiment. A slight fluctuation was noticed in water temperature throughout the experiment, and the average was 30° C.

Growth and survival

The growth and survival rates of red hybrid tilapia fed different diets are presented in Figure 1 and Table 1. The fish readily accepted oil coated diet and utilized it better than the fat coated diet. Among the fish fed with canola oil coated diets, the highest ($P < 0.05$) specific growth rate (SGR) was observed in the 5% canola oil coated diet (1.65 $\%d^{-1}$) followed by 10% (1.55 $\%d^{-1}$), 20% (1.38$\%d^{-1}$) and control (1.32$\%d^{-1}$) diets with the lowest rates. Among the fish fed the beef fat coated diet, the highest SGR ($P < 0.05$) was observed in the 5% beef fat enrichment diet (1.46$\%d^{-1}$) and the lowest in 20% beef fat coated diet (1.07$\%d^{-1}$). When comparing canola oil coated diets to beef fat coated diets, canola oil coated diets produced better performance than the beef coated diets. The best feed conversion ratio (FCR) was observed in fish fed 5% canola oil (0.972) and 5% beef fat (1.09) coated diets. All the treatments produced better survival (100%). No statistical difference was noticed in survival among the dietary groups.

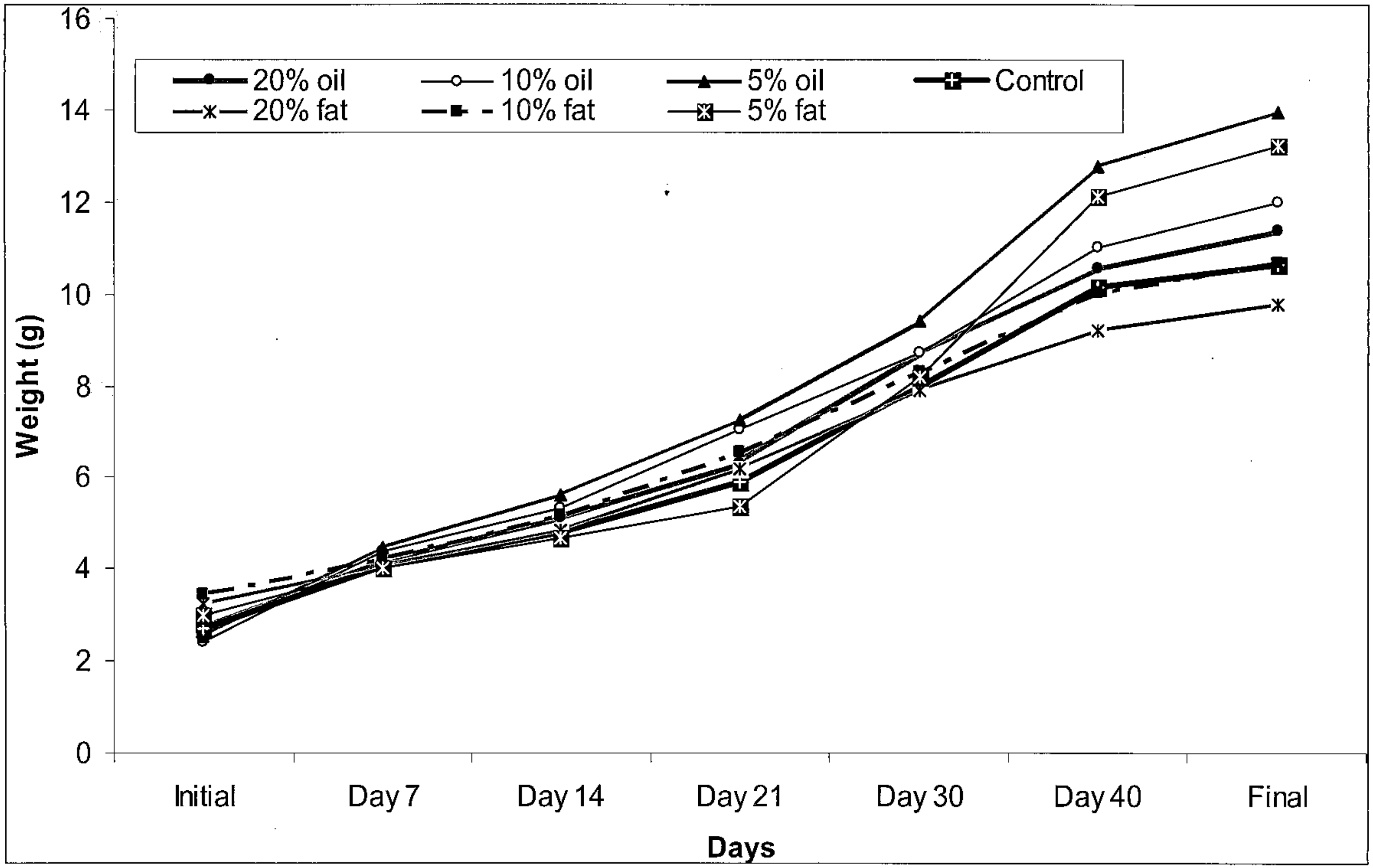

Figure 1. Weight (g) of red hybrid tilapia reared on different diets for 45 days

Table 1. Growth performance of red hybrid tilapia

PARAMETERS		CANOLA OIL COATED COMMERCIAL FEED			BEEF FAT COATED COMMERCIAL FEED		
	CONTROL	5% OIL	10% OIL	20% OIL	5% FAT	10% FAT	20% FAT
Initial weight (g)	2.7 ± 0.9	2.5 ± 0.8	2.4 ± 0.6	2.7 ± 0.5	2.9 ± 1.0	3.4 ± 1.5	3.2 ± 0.7
Final weight (g)	10.6 ± 2.8	13.9 ± 3.4	12.0 ± 3.4	11.3 ± 3.1	13.2 ± 2.2	10.7 ± 2.7	9.7 ± 3.7
Weight gain (g)	7.9	11.4	9.6	8.6	10.3	7.3	6.5
Weight gain (%)	292.5	456.0	400.0	318.5	355.1	214.7	203.1
SGR ($\%d^{-1}$)	1.32^{c}	1.65^{a}	1.55^{a}	1.38^{c}	1.46^{b}	1.10^{d}	1.07^{d}
FCR	1.39	0.972	1.17	1.27	1.09	1.42	1.57
Survival (%)	100	100	100	100	100	100	100

* Numbers with superscript similar alphabet did not significantly different at P < 0.05 level by one way ANOVA and Tukey's multiple range test

DISCUSSION

Nutritional studies on fish in the past have indicated that survival and growth depend on lipid sources supplemented to the diets [4]. In this investigation it was found that red hybrid tilapia juvenile fed dietary canola oil provided the best results in terms of specific growth rate, feed conversion ration and survival. This result may be due to the influence of fatty acids present in canola oil. The feeding regime was to satiation and statistically significant ($P < 0.05$) among dietary treatments, demonstrating at day 45. In the present investigation the highest growth rate was observed in fish fed 5% canola oil coated diet. This result was similar with the earlier findings of Bogut and Opacak [17] for *Oncorhynchus kistuch, O. keta, O. nerka, O. tshawytsch* and *O. mykiss*. Lipid requirement of African catfish *viz., Clarias gairepins, C. isheriensis, Heterobranchus longifili* and *H. kidorsalis*, Asian catfish *viz., C. batrachus, C. macrocephalus, C. focus* and *Heteropneustes fossilis* and European catfish *viz., Silunis glanis* also ranged between 5% and 10% [18].

Chou and Shiau [19] reported that a minimum of 5% dietary lipid should be provided in feeds for hybrid tilapia. Huang et al. [20] found no difference in growth and feed utilization efficiency in hybrid tilapia (*Oreochromis niloticus* x *O. aureus*) fingerlings fed 8% soybean oil or fish oil diet for 10 weeks. Fitzsimmons et al. [21] also did not find any significant differences in growth, feed utilization efficiency and carcass fat composition in Mozambique tilapia fed diets containing 3%, 6% and 8% dietary lipid levels. Hence they suggested that lower levels of dietary lipid could be used in tilapia feeds for intensive recirculation production systems provided the energy value of the diet is provided by suitable carbohydrate sources. Currently, fish farmers are using commercial tilapia feeds contain about 5% dietary oils, which is mostly incorporated with fish oils and it meets the minimum requirement of dietary lipids. Similarly the results of the present study also confirmed these earlier research findings. Studies on *Tilapia zilli* [22] indicated that graded levels of dietary oil up to 15% improved protein utilization efficiency. However, optimum dietary lipid level for various tilapia species has been reported to be between 10% and 15% depending on dietary ingredients used [20 and 22].

Among the two tested lipid sources canola oil produced better results in terms of growth. However canola oil, a rape-seed oil low in glucosinolates and erucic acid, having adequate content of the essential linoleic acid, is considered a useful ingredient in diets for cultured aquatic animals [5] so much, so that feeding low erucic acid rape-seed oil to Atlantic salmon (*Salmo salar*), juvenile Chinook salmon (*Oncorhynchus tschawytscha*), rainbow trout (*Oncorhynchus mykiss*), hybrid tilapia (*Oreochromis mossambicus* x *O. aureus*) and goldfish (*Carassius auratus*) did not negatively affect growth, feed conversion or survival rate [23, 24, 25, 26 and 27].

CONCLUSION

The present findings showed that 5% canola oil coating to commercial extruded diet enhanced the growth rate of the red hybrid tilapia.

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