

PRODUCTION EFFECT OF DIFFERENT COMMERCIAL FEEDS ON JUVENILE TENCH (*TINCA TINCA* L.) UNDER THE INTENSIVE REARING CONDITIONS

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Abstract

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Feeding experiment with juvenile tench was focused on evaluation of production effect of three different commercial feeds with differentiated level energy and protein (Karpico Crumble Excellent Ex, Dan Ex 1352, Pro Aqua Brutfutter). In the 42-day experiment at 26 °C, commercial starters were fed intensively to tench of initially 18.92 mm mean total length and 69.41 mg individual mean body weight. Main monitored indices were – survival rate (%), individual body weight (mg) and specific weight growth rate (%.d⁻¹). The best result was achieved with commercial starter Pro Aqua Brutfutter – mean individual body weight 483.38 mg, specific weight growth 4.44 %.d⁻¹ and survival 99.1%. Increasing level energy and protein increased production parameters of juvenile fish.

starter's feed, feeding, juvenile tench, fish breeding, *Artemia salina* nauplii

The tench (*Tinca tinca* L.) is species of great interest in Europe aquaculture. In the Czech Republic tench is traditionally reared in the fishponds since the 11th century. The tench production reaches 1–1.2% in the total production of Czech Republic, production of tench has got decreasing trend from 393 tons in 1997 to 284 tons in 2008. Europe production of tench has got also decreasing trend in the last ten years (1997–2008) from 2023 tons to 1262 tons (FAO, 2010). Traditional rearing of tench in ponds is unsatisfactory, mainly due to high mortality of the early life stages and poor growth rate of the tench during first weeks of the exogenous nutrition (Steffens, 1995).

Interest in the commercial cultivation of tench has increased in the past few decades. The fact that tench is interesting kind of fish for fish market, the problem of intensive rearing of fry under controlled conditions has become more important. The main question is whether tench fry can be fed on commercial dry diets while achieving satisfactory

growth with maximum survival. The utilization commercial diets could potentially improve growth and survival, as well as reduce cost of production tench in intensive rearing conditions in contrast with ponds conditions. Rearing post larval or juvenile tench is possible after rearing larval tench in intensive conditions. In the past two decades the several investigators confirmed possibility of rearing larvae tench in intensive conditions with satisfactory survival (Quirós and Alvaríño, 2000; Wolnicki and Gorny, 1995). In contrast to larvae tench which can be reared successfully on live food (*Artemia salina* nauplii), used solely or in combinations with dry diets, the most limiting factor for the rearing juvenile tench is the lack of commercially available starters. At the present, there are no specifically formulated dry diets for tench. Tench farming usually uses a variety of commercial diets such as those for carps, salmonids, or even for marine fish such sea bass or sea-bream (Quirós *et al.*, 2003). Quirós *et al.* (2003) tested four different commercial diets (trout starter,

trout first feeding, sea bass and eel), significantly higher survival rates and higher final weights were observed in the eel and sea-bass groups. Wolnicki *et al.* (2005) tested four commercial starters (Carp Starter, Uni Starter, Perla Plus and Asta), best results were achieved with starter Asta.

In the present 42-day study, three commercial dry diets with differentiated level crude protein, crude fat and gross energy, were fed to juvenile tench after an initial feeding of live food in recirculation system. The aim of feeding experiment was to observe if any of the commercial diets would be suitable for use in rearing tench under intensive controlled conditions.

MATERIAL AND METHODS

Fish

The experimental fish were pooled offspring of several spawners collected from ponds. Tench larvae were obtained from a commercial hatchery Štiptovň from Fish farm Nové Hradý (Czech Republic). The females were induced to ovulation in response to prepartate Ovopel, contains GnRH analogue and dopamine inhibitor (Horváth *et al.*, 1997), the males were not stimulated. At the beginning of the exogenous nourishment (6th day after hatching), the yolk-sac fry was transported to the experimental recirculation system of Department of Fisheries and Hydrobiology of the Mendel University in Brno, Czech Republic. Prior to the experiment the larvae of tench were hand fed with freshly hatched nauplia stages of the brine shrimp (*Artemia salina*) produced by Sanders Brine Shrimp Company for 24 days, larvae were fed eight times a day. Subsequently, for days 24–50, fish were fed commercial dry feed with using co-feeding as the optimal feeding strategy to transition onto dry feed, fish were fed three times a day, at 8:00, 13:00 and 18 hours. At the end of the preparatory period, the 50-day-old fish reached total length (TL) and individual body weight (IBW) of 18.92 ± 1.82 mm and 69.41 ± 18.40 mg (mean \pm SD, $n = 30$), respectively.

Diets and feeding

The 42-day feeding experiment was begun the day after completion of the preparatory period. Three feeding groups were designed, each in triplicate. Three commercial diets (Dan Ex 1352 – DanaFeed, Karpico Crumble Excellent Ex – Coppens International and Pro Aqua Brutfutter – Nutreco) were produced by important European fish feed producers with differentiated level crude protein, crude fat and gross energy. The commercial diets used in feeding experiment were classified with letters A, B and C according to amount of gross energy (A – diet Karpico Crumble Excellent Ex, B – Dan Ex 1352 and C – Pro Aqua Brutfutter). Nutrient and energy contents of diets are in Tab. I.

Feeding was performed manually three times a day during the light period, at 8:00, 13:00, and 18:00 hours. The feed ration was set as 1.25% metabolic

I: Crude protein (%), crude fat (%) and gross energy (MJ.kg⁻¹) of diets

| Experimental diet | A | B | C |
|-------------------------------------|------|------|------|
| Crude protein (%) | 45 | 52 | 57 |
| Crude fat (%) | 10 | 13 | 15 |
| Gross energy (MJ.kg ⁻¹) | 15.6 | 16.4 | 19.1 |

All the nutrient and energy values are presented in the feed matter and are declared by producers.

body weight. The actual feed ration was recalculated every 7th day, when samples were taken, according to the fish weight. Diameter of pellets was adjusted to fingerling size, ranged from 0.3 mm to 0.5 mm.

Facilities and water properties

The experiment was conducted for 42 days in the recirculation system with the biological filter, the ultra violet lamp, the heater system and the aeration system. The fish were stocked to the flow-through aerated glass aquarium of nine-liter volume, each initially stocked with 150 fish. The photoperiod regime was set as 16 hours of the light and 8 hours of dark. The water was heated to 26 °C (range \pm 0.5 °C). The dissolved oxygen saturation, measured twice a day, was maintained over 75%, pH was 7.7–8.1. Ammonia (N-NH₄⁺) and nitrite nitrogen (N-NO₂⁻) concentrations (mg.l⁻¹) remained below 0.5 and 0.05, respectively.

Measurements and data analysis

Every experimental variant was processed in triple repetition rate. The initial sample of 30 individuals was taken at the start of the experiment. The fish samples were taken every 7th day at the amount of 10 individuals per aquarium (30 per treatment). Final sample of 30 individuals per aquarium (90 per treatment) was taken at the final day of experiment (42 day). Sampled fish were killed by the carbon dioxide application and wet BW (\pm 0.1 mg) was determined. The samples were conserved in 4% formaldehyde solution for later measurement of the growth parameters. Main monitored indices were assessed according to Prokeš *et al.* (1997) – survival rate (S, %), individual body weight (IBW, mg), total length (TL, mm), specific weight and length growth rate (SWGR and SLGR, %·d⁻¹), food conversion ratio (FCR) and Fulton's factor of weight condition (FWC). The Protein Efficiency ratio (PER) was computed as followed: $PER = 100 / (FCR \cdot \% \text{ crude protein in feed matter})$. The ratio FCR/SWGR is value, which expressive production effect of feeds, decreasing this value expressive better production effect. The IBW was assessed using Mettler Toledo AB 204-S balance and TL using Vision Engineering Matis MST 2 binocular loupe.

The chemical composition of all diets as well as the fish bodies were determined in homogenized samples. Fish was killed by the carbon dioxide application. Sampling of these fish was performed in compliance with laws for the protection of animals against cruelty and was approved by the

Ethical Committee of the University of Veterinary and Pharmaceutical Sciences Brno, Czech Republic. Lipids were determined according to Soxhlet using a 12-h extraction by diethyl ether. Dry matter content was determined by drying the sample up to a constant weight at 105 °C (for 24 h). The content of nitrogenous substances was measured using the method by Kjehldahl and a Kjeltac 23 apparatus (Tecator, Sweden), with the net nitrogen determined being recalculated for nitrogenous substances (N x 6.25) and proteins, respectively.

Obtained data were statistically analysed and significance of ascertained difference was tested by Kruskal-Wallis single-factor analysis with subsequent multiple comparison (test of Scheffe) using STATISTICA software ($P < 0.01$).

RESULTS

Values of the production parameters under study, registered after termination of the feeding experiment are given in Tab. II. and Tab. III.

The highest IBW was gained by fry of the variant C, where fry was fed with starter feed Pro Aqua Brutfutter, while fry of the variant A (fed with Karpico Crumble Excellent Ex) had lowest IBW. Difference among values of individual body weight in variants A and C was statistically significant at $P < 0.01$. The similarly situation was in SWGR, where the highest value was gained in variant C. The TL and SL and also SLGR values were not significantly different in variants. The highest values of length parameters were registered in variant C. The significantly the lowest value of Fulton's factor of weight condition was found for fry of A variant, where fry was fed with Karpico Crumble Excellent Ex. Among values of FWC in variants B and C was not significantly difference. Survival rate of fish in all variants was over 97%, the highest survival rate was in variant C. Values of FCR in all variants were under value 2. The lowest value of FCR was in variant C and the highest in variant A. Ratio FCR/SWGR as

value, which expressive production effect of feeds was lowest in variant C.

Values found by the analysis of chemical composition of body of experimental fish are given in Tab. IV.

IV: Chemical composition of fish body at the end of the experiment

| Variant | Dry matter (%) | Protein (%) | Fat (%) |
|---------|----------------|-------------|---------|
| A | 21.39 | 13.40 | 7.03 |
| B | 22.44 | 13.18 | 8.38 |
| C | 20.92 | 12.47 | 8.09 |

The highest fat deposition was found in fry of the variant B, where fry was fed with DanEx 1352 with higher content of fat in variant A and lower content of fat in variant C. The low content of fat in the variant A (Karpico Crumble Excellent Ex) was reflected by lowest retention of body fat content in feeds tested.

DISCUSSION

All starters used in the present study resulted in satisfactory survival rates ranged over 97.5%. Other authors (Wolnicki *et al.*, 2005; Mareš *et al.*, 2007) also obtained the high survival in the feeding test with juvenile tench, as contrasted to papers (Ouirós and Alvriño, 1998; Quirós *et al.*, 2003), where survival for tench was unsatisfactory with feeding commercial diets. Feeding dry diets result in satisfactory survival for other juvenile cyprinids (Wolnicki, 1996; Myszkowski *et al.*, 2002). The growth intensity was increased subsequently with increasing content of protein and content of fat in used commercially diet, as well as reported Gasco *et al.* (2008). The weight growth intensity was highest for fry of variant C (feed Pro Aqua Brutfutter), as demonstrated by the SGR value, was superior by 9% as a mean, compared to this of variant A (feed Karpico Crumble Excellent Ex). The weight growth intensity of fry of all variants was higher than that reported Quirós *et al.* (2003),

II: Values of selected productive parameters after 42 days testing

| Variant | IBW (mg) | TL (mm) | SL (mm) | FWC | S (%) |
|---------|-------------------------------|---------------------------|---------------------------|--------------------------|-------|
| A | 378.06 ± 182.38 ^a | 29.20 ± 3.64 ^a | 23.98 ± 2.90 ^a | 2.54 ± 0.39 ^a | 97.5 |
| B | 424.86 ± 195.88 ^{ab} | 29.58 ± 3.88 ^a | 24.43 ± 3.30 ^a | 2.74 ± 0.39 ^b | 98.6 |
| C | 483.38 ± 196.60 ^b | 30.41 ± 3.71 ^a | 25.12 ± 2.90 ^a | 2.90 ± 0.36 ^b | 99.1 |

Dates are mean ± SD for n = 90, values with the same alphabetic markers within a column do not differ significantly ($P > 0.01$).

III: Values of selected productive parameters after 42 days testing

| Variant | SWGR (%.d ⁻¹) | SLGR (%.d ⁻¹) | FCR | FCR/SWGR | PER |
|---------|---------------------------|---------------------------|------|----------|------|
| A | 3.78 ± 1.13 ^a | 1.02 ± 0.29 ^a | 1.95 | 0.52 | 1.13 |
| B | 4.09 ± 1.05 ^{ab} | 1.04 ± 0.31 ^a | 1.66 | 0.41 | 1.16 |
| C | 4.44 ± 0.94 ^b | 1.11 ± 0.30 ^a | 1.37 | 0.31 | 1.28 |

Dates are mean ± SD for n = 90, values with the same alphabetic markers within a column do not differ significantly ($P > 0.01$).

the differences of weight growth intensity could be caused by initial body weight. Mareš *et al.* (2007) reached the highest SWGR values for fry fed with the ASTA, which had the highest content of protein and fat of diets used in their feeding experiment. Quirós *et al.* (2003) reached the highest SWGR with commercial feed used for Sea-bass (Dibaq). Values of the Fulton's factor of weight condition (FWC) ranged within 2.54–2.90 were higher than that reported Mareš *et al.* (2007) and Quirós *et al.* (2003). The highest value of FWC was found for fry fed with Pro Aqua Bruttfutter.

Food conversion ratio (FCR) reached from 1.37 to 1.95. The FCR was decreased with increasing growth rate. The highest FCR was reported in variant A, this value was 42% higher than value of FCR in variant C. In the presented experiment the FCR reached lower values than that reported for tench by Mareš *et al.* (2007). The values of PER were similar trend as values of FCR, the better values of PER were caused by higher growth rate. The values of PER reached from 1.13 to 1.28. The most effective utilization of the protein was found in variant C for tench fry with commercial feed Pro Aqua Bruttfutter (1.28).

The fat deposition reached from 7.03 to 8.09%. The lowest fat deposition was in variant A, fed Karpico Crumble Excellent Ex and the highest fat deposition was in variant B, fry fed DanEx 1352. The body fat deposition in variant B was superior by 18%, compared to the variant A. The body fat deposition was higher these commercial feed than that reported for tench fry Mareš *et al.* (2007), the deposition fat was within the range 4.48–6.74%.

Beside nutritional requirements, also breeding conditions affect produce parameters of tench. Timidity of tench and its stress sensitivity decrease ingestion feed and increases food conversion ratio (Wolnicki and Myszkowski, 1998; Rennert *et al.*, 2003).

On the basis our presented results we conclude that tench can achieve high survival (over 97.5%) under controlled rearing conditions. The best production effect was achieved with commercial feed Pro Aqua Bruttfutter with highest level energy and protein (crude protein – 57% and crude fat – 15%). Into the future for intensive rearing tench is necessary define optimal rearing conditions and exclude stress factors.

SUMMARY

The tench (*Tinca tinca* L.) is species of great interest in Europe aquaculture. In the Czech Republic tench is traditionally reared in the fishponds since the 11th century. Europe production of tench has got also decreasing trend in the last ten years (1997–2008) from 2023 tons to 1262 tons. Traditional rearing of tench in ponds is unsatisfactory, mainly due to high mortality of the early life stages and poor growth rate of the tench during first weeks of the exogenous nutrition. In the past few decades has increased interest of commercial cultivation of rearing of fry tench under intensive conditions. The main question is whether tench fry can be fed on commercial dry diets while achieving satisfactory growth with maximum survival. The utilization commercial diets could potentially improve growth and survival, as well as reduce cost of production tench in intensive rearing conditions in contrast with ponds conditions. Rearing post larval or juvenile tench is possible after rearing larval tench in intensive conditions. In contrast to larvae tench which can be reared successfully on live food (*Artemia salina* nauplii), used solely or in combinations with dry diets, the most limiting factor for the rearing juvenile tench is the lack of commercially available starters. At the present, there are no specifically formulated dry diets for tench. Tench farming usually uses a variety of commercial diets such as those for carps, salmonids, or even for marine fish such sea bass or sea-bream. In the present 42-day study, three commercial dry diets with differentiated level crude protein, crude fat and gross energy, were fed to juvenile tench after an initial feeding of live food in recirculation system. Commercial starters (with 45–57% crude protein and 10–15% crude fat) were fed intensively to tench of initially 18.92 mm mean total length and 69.41 mg individual mean body weight. The aim of feeding experiment was to observe if any of the commercial diets would be suitable for use in rearing tench under intensive controlled conditions. On the basis our presented results we conclude that tench can achieve high survival (over 97.5%) under controlled rearing conditions. The best production effect (mean individual body weight 483.38 mg, specific weight growth 4.44 %·d⁻¹ and survival 99.1%) was achieved with commercial feed Pro Aqua Bruttfutter with highest level energy and protein (crude protein – 57% and crude fat – 15%). Into the future for intensive rearing tench is necessary define optimal rearing conditions and exclude stress factors.

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