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Transition of Wild-Caught Juvenile Pikeperch, *Sander lucioperca* (Bogustkaya and Naseka, 1996) to Dry Feed Using Different Types of Food

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Abstract: Wild-caught juvenile pikeperch (*Sander lucioperca* (6.21±0.38 g and 7.80±0.24 cm) were offered different types of food and tested for their transition to dry feed. Totally 8 Groups (including Control) were fed according to the experimental feeding regime during 28 days. Group A (control) was fed with live *Gambusia affinis* fries alone. As initial feeding (the first 7 days of the experiment) before transition to dry feed, Groups B, C and D were offered live food, Groups E and F were offered moist feed (minced bait shrimp meat and minced fish meat, respectively). Group G and H were offered semi moist feed (a mixture of fish meat + dry feed and a mixture of bait shrimp meat + dry feed, respectively). To determine their preferences and acceptance of different feeds, some growth parameters were calculated for each group. The study showed that pikeperch in this size consumed all experimental diets and direct transition to dry feed could be achieved successfully after 7 days initial feeding with live food. The best weight gain was in Group A fed with live food alone (5.26±0.11g) ($p<0.05$), followed by Group B fed first with live and then dry feed (4.43±0.28g). Survival rates varied between 56 and 96%.

Key words: Pikeperch, feed, transition to dry feed, growth, survival, juvenile

INTRODUCTION

Pikeperch (*Sander lucioperca* Bogustkaya and Naseka, 1996) (Percidae) is one of the most popular and valuable freshwater fish species (Molnar *et al*., 2004; Ostaszewska, 2005). It is a piscivorous predator and hasn't been commercially cultured in intensive system except in some experimental studies; however, it has been cultured in extensive or semi intensive system for stocking in open waters and for angling (Ostaszewska, 2005; Lappalainen, 2001; Lappalainen and Dorner, 2003; Balik *et al*., 2006).

In recent years, attempts of intensification of pikeperch production have been undertaken in North America and some European countries such as Germany, Hungary, Poland and Sweden (Molnar *et al*., 2004; Ostaszewska, 2005; Ljunggren and Staffan, 2001). This species has been identified as candidate for aquaculture along with perch (*Perca fluviatilis* L.), yellow perch (*Perca flavescens* L.) and walleye (*Stizostedion vitreum* Mitchil) belonging to Percidae (Ljunggren *et al*., 2003).

The development of commercial fish culture industry depends on reliable and affordable supply of fingerlings which in turn depend on the success of their transition to formulated feeds. Based on previous studies on pikeperch it seems that their age is very important factor in the success of transition to dry feed (Xueliang *et al*., 2004; Kestemont *et al*., 2004). Pikeperch larvae showed very low growth and survival rates when fed with artificial feed alone (Ljunggren, 2002). Wedekind (2002) reported that the most useful way on the acceptability of artificial feed to pike-perch is supplementation of more natural food into artificial diets. Ljunggren (2003) and Ljunggren *et al*. (2002) reported some difficulties on acceptance of the formulated feed by pikeperch larvae and juvenile in a pond. High biological sensitivity of pikeperch in the period from hatching to the juvenile stage makes rearing of the larvae very difficult (Ostaszewska, 2005).

Since, the hatchery experiments on larval rearing of pikeperch have not been very promising so far, it seems capturing the wild pike perch juveniles from nature are still needed for commercial production. Due to the high biological sensitivity of wild pikeperch, transition of wild juveniles to artificial dry feed is very important process for commercial pike perch production. Therefore, in this study, wild-caught juvenile pikeperch were offered live, moist and semi moist food and tested for transition to dry feed.

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MATERIALS AND METHODS

Pikeperch juveniles were captured from Seyhan Dam Lake in the late spring and transported in plastic tanks (20 L) to the Freshwater Fish Research Station (FFRS), Faculty of Fisheries, University of Cukurova. To acclimate the wild-caught juveniles to culture conditions, fish was then stocked into 2 concrete raceways (4.75×1×0.75 m), the water of which was provided an via aqueduct from the same lake the fish were taken. They were kept there for a 2 week period. Fish was fed with live fish *Gambusia affinis* prior to commencing the experiment. The water in each raceway was treated with 5 g L^{-1} salt for first 2 days of the acclimation period to minimize risks against infections with pathogenic. After 2 weeks, 25 (~16 fish m^{-2}) fish (6.21±0.38 g and 7.80±0.24 cm) were stocked to each division randomly of 8 other raceways divided into 3 equal parts with net. The experiment was performed in triplicate. Usually, studies on transition or food acceptability are completed in a short time period (Molnar *et al*., 2004; Gordon *et al*., 1998; Hamre *et al*., 2001). Thus this transition study was performed as 28 day-period.

The surfaces of the raceways were shaded in order to maintain a stable environmental condition and to minimize the temperature changes. Water temperature and dissolved oxygen were measured daily. The mean values of these parameters were 25.45±0.27°C and 8.66±0.02 mg L^{-1}, respectively. Water flow rate was 7 L min^{-1} into each raceway. Bottoms of the raceways were siphoned and cleaned daily.

There were totally 6 different food types, which can be classified in live food, moist, semi moist and dry feeds; fries of *Gambusia affinis*, minced fish (trash tilapia) meat, minced bait shrimp (*Parapenaeus longirostris*) meat having low commercial importance, dry feed (trout larvae feed, 2 mm pellet size), a mixture of minced bait shrimp meat and ground dry feed (1:1) (mixture 1) and a mixture of minced fish meat and ground dry feed (1:1) (mixture 2).

Live *Gambusia affinis* fries were caught from water surroundings of FFRS and stocked into a pond for using as live food. The other experimental foods and dry feed were stored in a freezer until they were used for feeding.

All foods were analyzed for crude protein (Matissek *et al*., 1988), lipid (Bligh and Dyer, 1959) dry matter (Ludorf and Meyer, 1973) and crude ash (AOAC, 1984) in The Processing Laboratory of Fisheries Faculty, Cukurova University. Food types and their proximate chemical compositions were given in Table 1.

Totally 8 experimental groups were offered several foods mention above according to the experimental feeding regime outlined in Table 2. As it has been seen in Table 2, before transition to dry feed, each food type in each experimental Group was offered for a seven day-feeding period. To make the fish accustomed to next food type easier, each food was started to offer together with other food at the rate of 1:1 in the last 2 days of the previous feeding period.

Group A (control) was fed with live food alone during 28 days. In the first 7 days of the experiment, Group B, C and D were offered live food, Group E and F were offered moist food (minced bait shrimp meat and minced fish meat, respectively), Group G and H were offered semi moist food (mixture 1 and mixture 2, respectively).

Fish was fed ad libitum during the experimental feeding regime. Body weight (W±0.01g) and total length (L±0.1cm) of the fish were measured in the beginning and at the end of the experiment by using a cup filled with water. As indicators of acceptability of the feeds by fish, the growth performance was determined in terms of mean Final body Weight (g) (FW), Final total Length (cm) (FL), total Weight Gain (WG), total Length Gain (LG), Daily Growth Rate (g) (DGR), Specific Growth Rate (SGR), Condition Factor (CF) and Survival rate (S). These growth responses were calculated according to formula shown:

$$DGR = \frac{W2 - W1}{t}$$

Table 1: Food types and their proximate chemical compositions

Food types		Dry Matter (%)	Crude Protein (%)	Crude Lipid (%)	Ash (%)
Live food	*Gambusia affinis*	20.02±1.2	13.61±0.25	2.91±0.02	3.31±0.05
Dry feed	Trout larvae feed (2mm pellet size)	91.73±0.01	44.51±0.17	10.60±0.32	12.34±0.17
Moist foods	Bait Shrimp (*Parapenaeus longirostris*) meat *	56.25±0.13	32.98±0.35	7.89±0.32	9.97±0.14
Semi moist foods***	Fish meat**	23.19±0.05	19.13±0.098	1.70±0.01	1.39±0.2
	Bait shrimp meat+ dry feed	55. 32±0.09	30.73±0.34	8.89±0.32	6.13±0.09
	Fish meat + Dry feed	18.24±0.15	15.19±0.29	1.14±0.08	1.25±0.02

* having low commercial importance, ** (trash tilapia), *** prepared by mixing with dry feed at the rate of 1:1

Table 2: Experimental feeding regime in research groups

Treatment groups									
Treatment days		A (Control)	B	C	D	E	F	G	H
	5		Live food	Live food	Live food	Minced bait Shrimp meat	Minced Fish meat	Mixture 1*	Mixture2**
7									
	------		----------	----------	----------	----------	----------	----------	----------
	2		T***	T	T	-	T	T	T
		Live Food				T			
	5			Minced bait shrimp meat	Minced fish meat				
28	------			----------	----------				
	2			T	T				
21				Dry feed	Dry feed	Dry feed	Dry feed	Dry feed	Dry feed

*Minced bait shrimp meat + Dry feed, **Minced fish meat + Dry feed, ***Together with next food

$$SRG = \frac{\ln W2 - \ln W1}{t} \times 100$$

$$CF = \frac{W}{L^3} \times 100$$

$$S = \frac{LF}{TF} \times 100$$

Where, W1, W2 refer final and initial mean weight, t refers experimental time (days), L refers total length, LF refers the number of live fish, TF refers the number of total fish.

Statistical analyzes were carried out with Duncan's Multiple Range Test in SPPS Packet Program (SPSS, 1999).

RESULTS

The final body weight and total length of pikeperch juvenile in Group A (control Group fed live food alone) were found as 11.61±0.11 g and 11.45±0.22 cm and higher than the other Groups. This Group was followed by Group B fed first live and then dry feed. This result showed that direct transition of wild-caught pikeperch juveniles to dry feed could be achieved successfully after 7 days initial feeding with live food. Mean final body weight of Group A was significantly different ($p<0.05$) than those of the other Groups except Group B (Table 3). As a visual observation, all Groups were accepted all types of foods. Fish offered live food during either all the experiment or its first 7 days grew more than the other Groups. However, related to the body weight there were not significant differences between Groups B, D (which fed on live feed for a period) and H (which never fed on live feed). The same thing was also valid between Groups C, E, F (which fed on live feed for a period) and G (which never fed on live feed) ($p>0.05$).

The Groups C, E, G receiving minced bait shrimp meat had lower FW, FL, WG, LG, SGR, DGR values than those of Groups D, F, H used minced fish meat. It seems that using minced fish meat in feeding of pikeperch juveniles before transition to dry feed is more acceptable and preferable than using minced bait shrimp meat.

Fish length changed parallel with body weight. Results of Groups A and C showed statistically significant differences from the Groups A, C, E, F, G, H ($p<0.05$).

Mean SGR values of all Groups were between minimum of 0.55% and maximum of 2.18%. Mean SGR values of Groups A, B, D, G and H showed statistically significant differences compared to the values of the other Groups ($p<0.05$).

The highest and the lowest DGR values were seen at Group A (0.20 g) and G (0.04 g), respectively. The statistical differences of mean DGR were observed to be similar to those in their final mean body weight.

Two groups having high mean of CF were A (live feed) and H (mixture 2 then dry feed). The lowest CF (0.499) was seen at Group C during the experiment ($p<0.05$). CF of Group B was significant different from that of Group A, C and H ($p<0.05$).

As to mortality, Group A and B had each only 1 dead case, while the other Groups had three or more, which follows from this fact that, on the whole, the survival rates were observed to change between 56 and 96%. These rates were significantly higher in Groups A B, C, E and F than those in the other Groups ($p<0.05$).

DISCUSSION

Wild caught-pikeperch juveniles in the all experimental Groups of this study were able to consume each of the food types offered to themselves although the fish used in this study was larger than those used in previous studies of Molnar *et al.* (2000), Zakes (1997), Zakes *et al.* (1997) and Demska-Zakes and Zakes (1999). Total weight and total length gains of the fish in all Groups were between 1.04 and 5.26 g, 3.24 c and 5.60 cm, respectively during 28 days. Final body weights of

Table 3: Growth parameters, number of live fish and survival rate (%) of pikeperch according to the feeding groups

Groups parameters	A	B	C	D	E	F	G	H
Initial Weight (g)	6.21±0.38a	6.21±0.38a	6.21±0.38a	6.21±0.38a	6.21±0.38a	6.21±0.38a	6.21±0.38a	6.21±0.38a
Initial Length(cm)	7.80±0.24a	7.80±0.24a	7.80±0.24a	7.80±0.24a	7.80±0.24a	7.80±0.24a	7.80±0.24a	7.80±0.24a
FW (g)	11.61±0.11a	10.64±0.36ab	7.75±0.18c	10.04±0.46b	7.56±0.51c	7.72±0.43c	7.35±0.35c	9.71±0.20b
WG (g)	5.40±0.34a	4.43±0.28ab	1.54±0.15c	3.83±0.40b	1.35±0.26c	1.51±0.38c	1.14±0.28c	3.50±0.25b
FL (cm)	12..37±0.22a	12.45±0.22a	11.58±0.24b	12.03±0.65ab	11.12±0.24bc	11.21±0.29bc	11.09±0.32bc	11.70±0.01c
LG (cm)	4.57±0.32 a	5.65±0.23a	3.78±0.15b	4.23±0.48b	3.32±0.37c	3.41±0.25c	3.29±0.44c	3.90±0.26bc
SGR (%day-1)	2.23±0.01a	1.92±0.02b	0.78±0.03e	1.71±0.02c	0.70±0.03ef	0.75±0.03e	0.60±0.06f	1.59±0.07d
DGR (g)	0.19±0.01a	0.16±0.01ab	0.06±0.02c	0.14±0.02b	0.04±0.00c	0.05±0.01c	0.04±0.01c	0.13±0.07b
CF	0.613±0.03a	0.551±0.01b	0.499±0.00c	0.576±0.03ab	0.549±0.01ab	0.548±0.01ab	0.538±0.02b	0.606±0.01a
NL	24	24	21	14	21	22	14	14
S (%)	96±2.31a	96±2.70a	84±2.00b	56±2.08c	84±1.86b	88±1.52b	56±2.52c	56±2.31c

The means different letters in each column denote a significant difference ($p<0.05$). Each value is a mean ± s.e, (n = 3 replicates). NL shows number of live fish

Group A (control) and Group B (fed first with live and then dry feed) were similar to each other (Table 3), while being higher than those of the others. It is quite normal that the fish consuming live organism has a higher body weight, which was also observed in our experiment. Group B has a higher final body weight than those of the others except Group A. This result showed that direct transition of wild-caught pikeperch juveniles to dry feed can be achieved after a short time live food application without halting its growth. This result corresponds with the results of previous studies informed for smaller pikeperch by Molnar *et al.* (2000), Zakes *et al.* (1997), Demska- Zakes and Zakes (1999) and Zakes (1997).

Molnár *et al.* (2000) reported that a period of 10-40 days is required for pikeperch fingerlings to change gradually their feeding from zooplankton to minced fish diet. In this study, 2 days were enough to familiarize the new feed (transition). It can be said that the acceptation of feed by fish is easier when a feed of macro size is used.

This study indicates that the growth response of wild-caught pikeperch juveniles to minced bait shrimp meat (Groups E, C and F) was lower than those of juveniles fed with minced fish meat (Groups F, D and H) (Table 2) although the crude protein content of bait shrimp meat (32.98%, Table 1) is higher than those of fish meat (19.13%) (Table 1). For this reason, it can be said that bait shrimp meat has lower acceptability and effect on pikeperch growth than those of fish meat. Semi moist foods as mixture 1 (minced bait shrimp meat + dry feed) and mixture 2 (minced fish meat + dry feed) used in this experiment were prepared without nutritional balance. If these mixtures had been prepared in balance, the growth performance might have been higher than those obtained in the present study.

Zakes and Demska-Zakes (1996) reported that juveniles of pikeperch (3.66 cm total length and 0.32 g body weight) fed with commercial trout feed and zooplankton in 22°C during 15 weeks grew 14.56 g (daily 0.135 g) and 4.58 g (daily 0.04 g), respectively. Zakes *et al.* (1997) added hormone to the dry feed and fed the fish (2.33 g). Fish in control Group, which was fed on dry feed without hormone, was 7.33 g (0.238 g daily growth rate) at the end of the 21 days. Demska-Zakes and Zakes (1999) informed that pikeperch was be able to reach from 2.17 g to 6.95- 8.33 g (daily 0.22 g and 0.29 g) after being fed with hormone added commercial trout feed (18 h every day) during for 21 days. Zakes (1997) reported that pikeperch fry (mean 0.2 g weight and 3.02 cm total length) at 3 different stock ranges (0.6, 1.2 and 1.8g dm^{-3}) fed once every 4 min during 16 hours (28 days) could achieved to 1.81 and 1.90 g (daily 0.05 g and 0.06 g), 5.70 and 5.79 cm. Survival rate of the fries changed between 57.10 and 59.16%. In the present study, DGR values in the Groups E, F and G were found as 0.04 and 0.05g which were close to the results of Zakes (1997) but higher values were found between 0.13 and 0.19 g in the other Groups. The results in this study are quite important since transition was occurred in less feeding time and frequency compared to that carried out by Zakes (1997). All DGR values of this study were lower than those of Demska-Zakes and Zakes (1999). Differences between two studies can be explained with the feeding time and the hormone effect (anabolic) used in their study.

Mortalities in all Groups were not high, especially in Groups A and B (6%). This low mortality rates were not reported in previous studies. The highest mortality (44%) was similar to the results of Zakes (1999). According to the results of present study, it can be said that lower survival rates (56%) seen in some Groups (D, G, H) was not a result of feeding with different feeds. If it had been affected from feed types, a similar mortality rate would also have been observed in Group C, which is another Group fed on various feed.

CONCLUSION

There was no problem in accepting moist and semi moist food for wild-caught pikeperch juveniles (mean weight of 6.21 g) and transition to dry feed was successfully achieved. It was noticeable that the Group B fed first with live food (the first 7 days) then dry feed showed very good growth performance with very low mortality rate. It means, transition of these size wild caught pikeperch juveniles to dry feed needs less time (only 7 days live food application) and afford. Further study is needed on the proper feed components for commercial pikeperch culture.

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