Effects of Feeding Rate for Growth of
*Rutilus frisii Kutum* (Kamensky, 1901)

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**Abstract:** This study was conducted for 6 weeks in 4 groups and 3 replicate as follows: Group A = 2.5 % body weight per day, Group B = 5 % body weight per day, Group C = 7.5 % body weight per day and Group D = 10 % body weight per day. Initial body weight and length average were 0.984±0.182-gr and 4.6±0.223 cm. The physical and chemical performances were so controlled through the experiment that the amount of dissolved oxygen was fixed on 5.5 - 6 ppm, the temperature 26±2°C and pH 7.5 to 8. Fish were fed SFK (starting food kutum) commercial food during (6 weeks) of the study. Pertinent characteristics of this feed were: 32% crude protein; 10.5% crude fat; 11.2% ash and 8.7% moisture. The results show that there are significant differences with regard to the amount of body weight in different groups (P<0.05), so that the maximum body weight of *Rutilus frisii kutum* is in 10 % body weight per day. Results showed that hadn't significant effects in Specific Growth Rate (SGR), Body Weight Index (BWI %), Growth Rate (GR), Condition Factor (CF) and Survival (P>0.05) but had significant effects in Feed Conversion Ratio (FCR) in different groups (P<0.05). Results of this study showed that feeding 10 % body weight per day had best effect on growth and survival in *Rutilus frisii kutum*.

**Key words:** Feeding rate • Growth • Survival • *Rutilus frisii kutum*

**INTRODUCTION**

*Kutum* which is scientifically know as *Rutilus frissi kutum* (Kamensky, 1901) and belongs to *Cyprinidae* is one of the most economically important and valuable telostei in the Caspian Sea. This species exists only in this sea and its main habitation is largely restricted to the southern part of the Caspian Sea especially Iran's shores [1]. Fish is a primary source of protein for more than one billion people around the world [2]. Understanding of natural foods and dietary habits of fish culture could be an important factor in providing effective method of nutrition. Although intensive fish culture adaptability of the species with different feeding methods have been proven, but the choice of methods to provide food and nutrition in aquaculture should be considered dietary at patterns of normal behavior [3]. Feeding rate, water temperature, and fish size have a significant effect on the fish growth; in particular, the optimaum feeding rate has to be found in order to achieve a successful aquaculture operation [4]. In addition, feeding rate affects the usage of the nutrients in the feed [5]. Knowledge of the optimum feeding rate is important to improve best feed efficiency resulting better growth and production [6, 7]. Feeding costs contributes up to 60% of the variable costs of culture systems. Therefore, it is essential to provide a proper and applicable feeding management program. Overfeeding mostly causes feed spillage, decreasing in feed efficiency, and polluting the environment. Similarly, underfeeding results in decreased feed efficiency as well as degraded growth [8]. Therefore, it is essensial, in terms of both economy and biology, to determine the optimum feeding rate for growth [9]. It should be noted that optimal feeding rate is essential not only because of promoting best growth and minimizing feed conversion rate (FCR), but also for economic and environmental aspects, preventing water quality degradation [4].

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Results of other studies on different fish species showed that feeding rate on different species of fish are varies and should be determined for each fish species separately and review. Currently, there is no published information on the effects of feeding rate on growth of kutum fry. It is necessary to have a better understanding of the optimum feeding rate of this species. The objective of this study was to determine optimum and maintenance feeding rate and the effects of the feeding rate on growth performances and survival for kutum, *Rutilus frisii kutum* fry.

**MATERIALS AND METHODS**

**Experimental Design:** This study was operated as long as 6 weeks and in 12 tanks with 30 numbers fish in each tank, with 4 groups and 3 replicate as: Group A = 2.5 % body weight per day — BW d-1, Group B = 5 % body weight per day — BW d-1, Group C = 7.5 % body weight per day — BW d-1 and Group D = 10 % body weight per day — BW d-1. Daily groups were fed four times a day (equal meals at 08:00, 11:00, 14:00 and 17:00 h) by hand according to feeding rates, making sure that no feed was left uneaten. Initial body weight and length average were 0.984±0.182 gr and 4.6±0.223 cm. Given the importance of the physical and chemical performances and their impact on water supply and ultimately the fish growth, these performances were so controlled through the experiment that the amount of dissolved oxygen was fixed on 5.5 - 6 ppm, the temperature 26±2°C and pH 7.5 to 8. Fish were fed SFK commercial feed during (6 weeks) of the study. The feed was administered only during daylight hours. Pertinent characteristics of this feed were: 32% crude protein; 10.5% crude fat; 11.2% ash and 8.7% moisture. Fish were sampled every 2 weeks to evaluate growth in weight and length, for this purpose 10 numbers of fish in each tank were captured, weighed and measured. After each sampling period the amount of feed given was adjusted according to mean weight in each aquarium. From results of the last sample fish performances were evaluated in terms of Feed Conversion Ratio (FCR), Specific Growth Rate (SGR, % d-1), Body Weight Index (BWI %), Growth Rate (GR, gr d-1), Condition Factor (CF, gr/Cm) and Survival (%). These performance indices were calculated as follows [10-12]:

- FCR= total feed intake/ total biomass gain
- SGR= [(ln final weight-ln initial weight)/ rearing duration in days] ×100
- BWI= [(body weight final-body weight initial)/ body weight initial] ×100
- GR= (body weight final-body weight initial)/ rearing duration in days
- BWI= [(body weight /total length)] ×100
- Survival= (number of fish harvested/number of fish stocked) ×100

**Statistical Analysis:** Finally, SPSS version 13 and a software program for drawing graphs of Excel 2003 have been used to analyse all data. All data were analyzed with one-way analyses of variance (ANOVA) and significant means were subjected to a multiple comparison test Duncan at P<0.05. When the normality of data did not present, the nonparametric test Kruskal-Wallis to compare groups and test Mann - Whitney for paired comparison between groups were used.

**RESULTS AND DISCUSSION**

Final body weight of *Rutilus frisii kutum*in different groups are shown in Fig. 1. Obtained results at the end of this study showed that feeding rates had significant effects on body weight of *Rutilus frisii kutum* (P<0.05). The results show that there is significant difference with regard to the amount of body weight in different groups (P<0.05), so that the maximum body weight of *Rutilus frisii kutum* is in 10 % body weight per day.

Final body length of *Rutilus frisii kutum* in different groups are shown in Fig. 2. The results show that there isnt significant difference with regard to the amount of body length in different groups (P>0.05).

Comparison average of different feeding rate effects on *Rutilus frisii kutum* growth performances during culture period are shown in Table 1. Results showed that hadn't significant effects in Specific Growth Rate (SGR), Body Weight Index (BWI %), Growth Rate (GR), Condition Factor (CF) and Survival (P>0.05) but had significant effects in Feed Conversion Ratio (FCR) in different groups (P<0.05).

In this study, significant differences in BWI, SGR, GR, CF and Survival were not observed among groups (P>0.05) (Table. 1). Although, the SGR and GR increased with increasing feeding rate to 10% BW d-1 but hadn't significant effects in different groups (P>0.05). Also, the best FCR were observed in 2.5% BW d-1 (P<0.05). The highest growth in the present study typically occurred in the 10% BW d-1 group.
Fig. 1: The average of body weight of *Rutilus frisii kutum* in different groups
The small Latin letters show that there are significant differences among different treatments

![Graph showing body weight comparison](image)

This figure shows the average body weight of *Rutilus frisii kutum* in different groups. The small Latin letters indicate significant differences among the treatments.

Fig. 2: The average of body length of *Rutilus frisii kutum* in different groups
The small Latin letters show that there are no significant differences among different treatments

![Graph showing body length comparison](image)

This figure illustrates the average body length of *Rutilus frisii kutum* in different groups. The small Latin letters indicate no significant differences among the treatments.

Table 1: Effects of different feeding rate on growth performances in kutum

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
<th>Group D</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCR (dry weight)</td>
<td>3.34±0.31</td>
<td>4.8±0.64</td>
<td>6.56±0.71</td>
<td>6.32±0.375</td>
</tr>
<tr>
<td>SGR (%/Day)</td>
<td>7.94±2.42</td>
<td>10.96±0.92</td>
<td>11.19±0.758</td>
<td>11.59±1.74</td>
</tr>
<tr>
<td>BWI (%)</td>
<td>9.23±2.76</td>
<td>14.22±1.86</td>
<td>13.94±1.8</td>
<td>13.37±3.66</td>
</tr>
<tr>
<td>GR (gr/Day)</td>
<td>0.009±0.003</td>
<td>0.013±0.0017</td>
<td>0.0137±0.0014</td>
<td>0.0148±0.0036</td>
</tr>
<tr>
<td>CF (gr/Cm)</td>
<td>1.109±0.36</td>
<td>0.96±0.069</td>
<td>0.97±0.077</td>
<td>0.919±0.075</td>
</tr>
<tr>
<td>Survival (%)</td>
<td>93.33±2.5</td>
<td>95.23±4.16</td>
<td>94.28±3.76</td>
<td>92.23±1.86</td>
</tr>
</tbody>
</table>

*The small Latin letters show that there are significant differences among different treatments*

The quantity and quality of the ration have a significant effect on growth rate, efficiency of feed utilization, and chemical composition [4, 13-16]. Therefore, it is necessary to determine the optimal feeding rate for different species. Fish requires a daily ration for maximum growth [17, 18]. Fish feeding is one of the most important performances in aquaculture because of high feed costs. Overfeeding causes degradation of water quality; consequently, the fish growth reduces and cost increases. On the other hand, underfeeding is undesirable. Therefore, it is critical to find the optimum feeding rate from both economical and biological point of view [9]. In this work, maximum growth of kutum fed at 10% BW d-1. A similar result was also found in some species. Silva et al. [19] showed that increasing feeding rate on *Colossoma macropomum* with 10% BW d-1 is more growth. Also, studies on other fish such as *Mystus nemurus* [20], *Dicentrarchus labrax* [7], *Ictalurus punctatus* [21] and *Piaractus mesopotamicus* [22] showed that feeding rate with 10% BW d-1 fish growth was better.

The optimal feeding strategies augment growth performance, survival, and feed conversion ratios. Additionally, it contributes to minimize feed wastage, reduce size variation, and accordingly, increase production efficiency [23, 24].
Results of other studies are different in various species. Studies with several fish species have revealed that with increasing feeding rate, the growth increases at higher ration levels and decreases at lower ration levels [5, 20, 25-28].

The discrepancies between the results of this study and the findings of others could be explained by size and/or age differences of fish and experimental conditions such as feeding regimes [29-31]. For instance, Hung et al. [32] observed that optimum feeding rate for striped bass fry (initial body weight 38 g) was 1.0–1.5% BW/day. In similar size, optimum feeding rate was suggested to be 2.0 BW/day for the same species (>27 g) kept by Piper et al. [33]. It is well known that feeding rate and feed consumption in relation to body weight decreases as fish grow [20, 30, 34]. A feeding rate of 4.0% BW/day for gilthead sea bream at 3-g initial average weight but 6.0% BW/day at 1-g initial average weight was suggested to be optimal [7, 35, 36].

The result of this research on the effects of the fish feeding rate has been different from other studies. However, research results show that the feeding rates and growth rate are different in different species. Based on growth performance, the highest growth was obtained with fish fed 10% BW/day, in the present study. It appears that, feeding 10% BW/day to satiation may be accepted as sufficient for on growing of kutum under the conditions of this experiment.

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REFERENCES


